

FCNDT 2026

第二屆 非破壞檢測技術國際研討會 暨 財團法人台灣非破壞檢測協會年會 2nd Formosa Conference on Non-Destructive Testing

National Central University (NCU)

15-16 October 2026



國立中央大學
National Central University



財團法人台灣非破壞檢測協會
The Society for Nondestructive Testing
& Certification of Taiwan (SNTCT)

贊助單位 / Sponsors

精林企業有限公司	台灣檢驗科技股份有限公司
皇威檢驗有限公司	台灣動力檢測科技股份有限公司
台灣電力股份有限公司	禾翔實業有限公司
中國非破壞檢驗有限公司	世翔檢驗科技有限公司
中國鋼鐵股份有限公司	全國工程檢驗有限公司
汎亞工程檢測有限公司	力升工業檢測有限公司
華榮檢測股份有限公司	通用非破壞檢驗有限公司
台陞工程檢驗有限公司	駿傑工程檢驗有限公司
弘霖工程檢驗有限公司	鈦田技術顧問有限公司
承標工業有限公司	唯泰工業檢驗有限公司
耀武工程有限公司	長榮鋼鐵股份有限公司
鴻益科技工程檢驗有限公司	中國鋼鐵結構股份有限公司
台灣金屬材料品管有限公司	泰瑞工業檢驗有限公司
台塑石化股份有限公司	中銓興業有限公司
禾翔實業有限公司	允強實業股份有限公司

Table of Content 目錄

Table of Content 目錄	1
Welcome Address from Conference Chair 大會主席致詞	3
Committee 委員會	8
Call for Papers	12
徵稿文件	13
Conference Venue 會議地點	14
Program at a Glance 議程一覽	17
Program Schedule 研討會議程表	18
PS1: Plenary Speech 1, 大會演講 1	37
PS2: Plenary Speech 2, 大會演講 2	39
PS3: Plenary Speech 3, 大會演講 3	41
PS4: Plenary Speech 4, 大會演講 4	43
PS5: Plenary Speech 5, 大會演講 5	45
EF1: Expert Form 1, 專家座談 1	47
EF2: Expert Forum 2, 專家座談 2	49
EF3: Expert Forum 3, 專家座談 3	52
EF4: Expert Forum 4, 專家座談 4	54
EF5: Expert Forum 5, 專家座談 5	56
SS4: Advanced Electromagnetic Testing Invited Talks, 先進電磁測試專家演講 ...	58
EC: English Competition, 英文論文競賽	60
CC: Chinese Competition, 中文論文競賽	67
CP: Chinese Poster Session, 中文海報競賽	72
EP: English Poster Session, 英文海報競賽	86
E-SS1: Advanced Optical Metrology, 先進光學量測技術	97
E-SS2: AI and NDE 4.0, 人工智慧與非破壞評估 4.0	103
E-SS4: Advanced Electromagnetic Testing, 先進電磁測試	108
C-SS1: Advanced Optical Metrology, 先進光學量測技術	113

C-SS2: AI and NDE 4.0, 人工智慧與非破壞評估 4.0.....	118
C-SS3: Guided Wave NDT, 導波非破壞檢測	123
C-SS5: Advanced Vibration Testing, 先進振動測試	126
C-SS6: Inspection for Nuclear Power Plants, 核電廠檢測.....	130
C-SS7: Civil NDT, 土木非破壞檢測.....	135
E-R1: Advanced NDT Technologies and Applications, 先進非破壞檢測與應用..	139
E-R2: Metrology, 量測	146
C-R1: Ultrasonic Testing (UT), 超音波檢測	151
Author/Chair Index 作者/主席索引	156

2nd Formosa Conference on Non-Destructive Testing
(FCNDT 2026)

2026 第二屆非破壞檢測技術國際研討會 暨
財團法人台灣非破壞檢測協會年會

Welcome Address from Conference Chair
大會主席致詞

Distinguished guests, esteemed colleagues, and friends in the field of non-destructive testing:

The Society for Nondestructive Testing and Certification of Taiwan (SNTCT) holds its Annual Meeting and Non-Destructive Testing Technology Conference every two years. This year, on October 15-16, SNTCT and National Central University will jointly host the 2026 Annual Meeting and the 2nd Formosa Conference on Non-Destructive Testing (FCNDT 2026).

The organization of FCNDT marks an important milestone in advancing the internationalization of professional exchange in non-destructive testing in Taiwan. Following the successful inaugural conference in 2024, this year's event further expands international participation and professional exchange, with the aim of establishing an important platform connecting Taiwan with the Asia-Pacific region and the global NDT community. Experts, scholars, and practitioners from industry, academia, research institutions, and professional organizations in Taiwan and abroad will gather at National Central University to share the latest research findings, technological developments, and engineering practices, and to foster closer collaboration among industry, government, academia, and research communities. On behalf of the Conference Organizing Committee, I extend my warmest welcome to all participants. We are especially honored by the presence of Dr. Makoto Ochiai, President of the Japanese Society for Non-Destructive Inspection (JSNDI), and Dr. Ilham Mukriz (Zainal Abidin), President of the Malaysian Society for Non-Destructive Testing (MSNT), whose attendance makes this occasion particularly meaningful.

With the rapid development of advanced manufacturing, the energy transition, smart infrastructure, and digital technologies, non-destructive testing is playing an increasingly important role. This conference covers a wide range of topics, including advanced optical measurement, artificial intelligence and NDE 4.0, advanced electromagnetic testing, non-destructive testing in civil engineering, nuclear power plant inspection, guided-wave non-destructive testing, and advanced vibration testing, highlighting the trend toward interdisciplinary integration and innovative applications of NDT technologies. Five Plenary Speeches have been specially arranged, featuring distinguished experts from Taiwan and abroad, Dr. Makoto Ochiai, Prof. Younho Cho, Prof. Liang-Chia Chen, Prof. Che-Hua Yang, and Prof. Jaesun Lee, will share their latest research findings and professional perspectives, enabling participants to gain insight into international developments in NDT and advanced measurement technologies.

In addition, five Expert Forums have been organized on the following themes: offshore wind power inspection practices; semiconductor inspection technologies; ISO 9712 and the current status of Taiwan's personnel certification system; the development and application of non-destructive testing technologies for power plant decommissioning and restart; and developments in NDT applications for steel structures. These topics span renewable energy, high-tech manufacturing, professional personnel certification, energy facilities, and steel-structure safety, fully reflecting the close relationship between NDT technologies, current industrial development, and public safety needs.

FCNDT is not only a platform for presenting research achievements, but is also intended to serve as an important bridge connecting research, technology, talent, and industrial needs. Through plenary speeches, expert forums, thematic sessions, paper competitions, technical presentations, and corporate exhibitions, we look forward to promoting exchange across disciplines and generations, while encouraging young researchers, engineers, and students to participate actively and broaden their professional and international perspectives.

We hope that FCNDT 2026 will provide all participants with opportunities to share knowledge, inspire new ideas, build friendships, and initiate new

collaborations. Together, we will advance the innovation and application of non-destructive testing technologies and continue moving toward our vision of "Deepening Roots in Taiwan, Connecting the Asia-Pacific, and Pursuing Global Excellence."

I wish FCNDT 2026 every success and all participants a rewarding and fruitful conference experience!

Sincerely,



Juin-Fu Chai

President

Society for Nondestructive Testing and Certification of Taiwan (SNTCT)

October 15, 2026

各位貴賓、先進與非破壞檢測領域的朋友們：

台灣非破壞檢測協會每兩年舉辦一次年會及非破壞檢測技術研討會，今年則於 10 月 15-16 日與國立中央大學共同主辦 2026 年會及第二屆福爾摩沙非破壞檢測技術國際研討會(2nd Formosa Conference on Non-Destructive Testing, FCNDT 2026)。

FCNDT 的舉辦，象徵台灣非破壞檢測專業交流邁向國際化的重要里程碑。繼 2024 年第一屆大會成功舉辦後，本屆持續擴大國際參與及專業交流，期望建立一個連結臺灣、亞太地區與全球 NDT 社群的重要平台，邀集來自國內外產業界、學術界、研究機構及專業組織的專家學者與從業人員齊聚於國立中央大學，共同分享最新研究成果、技術發展與工程實務經驗，促進產、官、學、研各界更緊密的合作。謹代表大會籌備委員會，誠摯歡迎各位，尤其是日本非破壞檢測協會(JSNDI)會長 Dr. Makoto Ochiai 與馬來西亞非破壞檢測協會(MSNT)會長 Dr. Ilham Mukriz (Zainal Abidin)親自蒞臨指導，更難能可貴。

隨著先進製造、能源轉型、智慧基礎設施及數位科技快速發展，非破壞檢測的角色日益重要。本屆大會涵蓋先進光學量測、人工智慧與 NDE 4.0、先進電磁測試、土木非破壞檢測、核電廠檢測、導波非破壞檢測及先進振動測試等多元主題，展現 NDT 技術跨領域整合與創新應用的發展趨勢。本屆特別安排五場大會演講，邀請 Dr. Makoto Ochiai、Prof. Younho Cho、Prof. Liang-Chia Chen、Prof. Che-Hua Yang 及 Prof. Jaesun Lee 等國內外傑出專家，分享最新研究成果與專業觀點，讓與會者掌握 NDT 及先進量測技術的國際發展趨勢。此外，大會規劃五場專家座談，主題分別為離岸風電檢測實務、半導體檢測技術、ISO 9712 與國內授證制度現況、非破壞檢測技術在電廠除役及再運轉之發展與應用，以及鋼結構 NDT 應用發展。這些議題從再生能源、高科技製造、專業人員認證延伸至能源設施及鋼結構安全，充分反映 NDT 技術與當前產業發展及公共安全需求的密切關聯。

FCNDT 不僅是研究成果發表的平台，更期望成為研究、技術、人才與產業需求之間的重要橋梁。透過大會演講、專家座談、專題研討、論文競賽、論文發表及企業展示，我們期待促進不同領域與世代間的

交流，並鼓勵青年研究人員、工程師及學生積極參與，拓展專業與國際視野。

期待 FCNDT 2026 能讓各位分享知識、激盪創意、建立友誼並開啟新的合作機會，共同推動非破壞檢測技術的創新與應用，持續朝向「深耕臺灣、鏈結亞太、卓越全球」的願景邁進。

敬祝 FCNDT 2026 大會圓滿成功，各位與會貴賓收穫豐碩！

財團法人台灣非破壞檢測協會董事長



柴駿甫 謹致

中華民國 115 年 10 月 15 日

Committee 委員會

Conference Chair: Juin-Fu Chai (National Center for Research on Earthquake Engineering, National Institutes of Applied Research, TW)	大會主席：柴駿甫 (國家地震工程研究中心)
Conference Co-Chair: Ju-Yi Lee (National Central University, TW)	共同主席：李朱育 (國立中央大學)
Advisory Board Chair: Ching-Chung Yin (National Yang Ming Chiao Tung University, TW) Chih-Hung Chiang (Chaoyang University of Technology, TW)	諮詢委員會主席： 尹慶中 (國立陽明交通大學) 江支弘 (朝陽科技大學)
Advisory Board Co-Chair: Takamasa Ogata (APFNDT, JP)	諮詢委員會共同主席：Takamasa Ogata (APFNDT, JP)
Advisory Board Member: Ilham Mukriz Zainal Abidin (MSNT, MY) Sajeesh Kumar Babu (ICNDT, SG) Krishnan Balasubramanian (ISNT, IN) Tsuchin Philip Chu (Southern Illinois University, USA) Ikuo Ihara (JSNDI, JP) Kyung-Young Jhang (KSNT, KR) Danny Keck (ASNT, USA) Chia-Chi Cheng (Chaoyang University of Technology, TW) Chung-Yue Wang (National Central University, TW) Che-Hwa Yang (National Taipei University of Technology, TW) Reza Zoughi (Iowa State University, USA) Takahide Sakagami (Kobe University, JP)	諮詢委員會成員： Ilham Mukriz Zainal Abidin (MSNT, MY) Sajeesh Kumar Babu (ICNDT, SG) Krishnan Balasubramanian (ISNT, IN) Tsuchin Philip Chu (Southern Illinois University, USA) Ikuo Ihara (JSNDI, JP) Kyung-Young Jhang (KSNT, KR) Danny Keck (ASNT, USA) 鄭家齊 (朝陽科技大學) 王仲宇 (國立中央大學) 楊哲化 (國立台北科技大學) Reza Zoughi (Iowa State University, USA) Takahide Sakagami (Kobe University, JP)
Organizing Committee: Ju-Yi Lee, Po Ting Lin, Yung-Shun Su	組織委員會：李朱育、林柏廷、蘇詠舜

Technical Committee Members: Ching-Chung Yin, Chung-Yue Wang, Shyh-Hau Wang, Hao-Lin Wang, Chih-Hung Chiang, Chao-Ching Ho, Tsung-Tsong Wu, Ju-Yi Lee, Yung-Chun Lee, Bing-Hung Li, Yi-Ching Lin, Yi-Chuang Wu, Wen-Chuan Wu, Yi-Ching Lin, Po Ting Lin, Yung-Chiang Lin, Chin-Lung Chiu, Jia-Hong Sun, Juin-Fu Chai, Keng-Tsang Hsu, Mao-Kuen Kuo, Wen-Shiang Chen, Yung-Yu Chen, Chin-Chi Chen, Kuo-Chih Chuang, Peng-Chi Peng, Jian-Hua Tong, Yu-Hsi Huang, Che-Hua Yang, Shih-Kuang Yang, Jiunn-Woei Liaw, Kuang-Chih Pei, Chan-Yi Liao, Pei-Ling Liu, Chia-Chi Cheng, Hung-Lin Hsieh	技術委員： 尹慶中、王仲宇、王士豪、王顥霖、江支弘、何昭慶、吳政忠、李朱育、李永春、李秉鴻、李雨青、吳亦莊、吳文銓、林宜清、林柏廷、林永強、邱進隆、孫嘉宏、柴駿甫、許耿蒼、郭茂坤、陳文翔、陳永裕、陳清祺、莊國志、彭朋畿、童建樺、黃育熙、楊哲化、楊旭光、廖駿偉、裴廣智、廖展誼、劉佩玲、鄭家齊、謝宏麟（依姓氏筆畫排序）
Organizers: The Society for Nondestructive Testing & Certification of Taiwan (SNTCT) National Central University (NCU)	主辦單位：財團法人台灣非破壞檢測協會、國立中央大學
Co-Organizer: National Taiwan University of Science and Technology (NTUST)	協辦單位：國立臺灣科技大學
Sponsors: Jing Lin Enterprise Co., Ltd. Huang-Wei Non-Destructive-Examination Co., Ltd. Taiwan Power Company China Non-Destructive Inspection Co., Ltd. China Steel Corporation Pan Asia Engineering Testing Co., Ltd. Hwa-Rong Testing Corporation Times Construction Inspection Co., Ltd. Horng Lin Non-Destructive Inspection Co., Ltd. NDE-PRO Industrial Co., Ltd.	贊助單位： 精林企業有限公司 皇威檢驗有限公司 台灣電力股份有限公司 中國非破壞檢驗有限公司 中國鋼鐵股份有限公司 汎亞工程檢測有限公司 華榮檢測股份有限公司 台陞工程檢驗有限公司 弘霖工程檢驗有限公司

Yao-Wu Engineer. Co., Ltd. Hong Yi Technology Engineering Inspection Co., Ltd. Taiwan Metal Quality Control Co., Ltd. Formosa Petrochemical Corporation Hoi Hsang Industrial Co., Ltd. Shih Siang Inspection Technology Co., Ltd. Chiuan Kuo Non-Destructive Inspection Co., Ltd. Li Sen Engineering Inspection Co., Ltd. Tung Yung Non-Destruction Inspection Co., Ltd. Jun Jie Engineering Inspection Co., Ltd. Tai Tien Technology Consulting Co., Ltd. Wei Tai Industrial Inspection Co., Ltd. SGS Taiwan Ltd. Taiwan Power Testing Technology Co., Ltd. Evergreen Steel Corporation China Steel Structure Co., Ltd. Tai-Ray Industrial Inspection Co., Ltd. Jong Chyuan Industry Co., Ltd. YC INOX Co., Ltd.	承標工業有限公司 耀武工程有限公司 鴻益科技工程檢驗有限公司 台灣金屬材料品管有限公司 台塑石化股份有限公司 禾翔實業有限公司 世翔檢驗科技有限公司 全國工程檢驗有限公司 力升工業檢測有限公司 通用非破壞檢驗有限公司 駿傑工程檢驗有限公司 鈦田技術顧問有限公司 唯泰工業檢驗有限公司 台灣檢驗科技股份有限公司 台灣動力檢測科技股份有限公司 長榮鋼鐵股份有限公司 中國鋼鐵結構股份有限公司 泰瑞工業檢驗有限公司 中銓興業有限公司 允強實業股份有限公司
Exhibitors: Kingyoup Enterprises Co., Ltd. Wain Tsiang Enterprise Co., Ltd. Microtek International Inc. Ai-Kwang Tech Co., Ltd. Taiwan NDT Association Taiwan Maxwave Co., Ltd. Magicedot Corporation Medical Intubation Technology Corporation SENTRA Int. Co., Ltd.	展覽單位： 勤友企業股份有限公司 萬匠企業股份有限公司 全友電腦股份有限公司 愛光科技股份有限公司 中華民國非破壞檢測商業同業公會 台灣波律股份有限公司 妙點企業股份有限公司 醫電鼎眾股份有限公司

SPDTech	先創國際股份有限公司
Justexin Test Technology Corp.	SPDTECH(韓國廠商)
Almatec Co., Ltd.	嘉信檢測科技股份有限公司
Baidon Enterprise Co., Ltd.	歐測股份有限公司
Keiyu NDT Supply Co.	百冬企業有限公司
Guided Ultrasonics Ltd.	克鈺企業有限公司
The Japanese Society for Non-Destructive Inspection (JSNDI) / Asia Pacific Federation for Non Destructive Testing (APFNDT)	凱德威 GUL 有限公司
	JSNDI/APFNDT

Call for Papers



The 2nd Formosa Conference on Non-Destructive Testing (FCNDT 2026) is organized by the Society for Non-destructive Testing & Certification of Taiwan (SNTCT). FCNDT 2026 will take place in the National Central University. This conference invites professionals from across the industry and academia to actively participate, connect, and collaborate. Please find the detailed information at <https://www.sntct-eng.org/fcndt2026>.



Focus and Scope

Mechanical Engineering	Electronics and Electrical Industry	Aerospace Engineering
Petrochemical Industry	Rail Transportation and Traffic Industry	Advanced Manufacturing
Energy Industry	Infrastructure and Civil Construction	Biomedical Field



Methods and Techniques

Acoustic Emission (AE)	Electromagnetic Testing (ET)	Infrared Testing (IRT)
Leak Testing (LT)	Magnetic Testing (MT)	Penetrant Testing (PT)
Radiographic Testing (RT)	Ultrasonic Testing (UT)	Visual and Optical Testing (VT/OT)
Structural Health Monitoring	Modeling and Simulation	NDT-General
Personnel Training and Certification	Quantitative NDT	Standardization
Wind Turbine (WT)	NDE 4.0 / AI	Biomedical Testing



Submission Guideline and Important Dates

Participants can submit papers for
(a) paper competitions or (b) regular publications.
Each submission could be for
(1) oral presentation or (2) poster presentation.

Guideline of paper length:

- (a1) Oral paper competition: 10–12 pages.
- (a2) Poster paper competition: 2–12 pages.
- (b1) Oral regular paper: 3–12 pages.
- (b2) Poster regular paper: 2–12 pages.

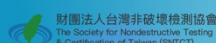
Important Dates:

- * Paper Submission Deadline : 9/6, 2026 Extended to 9/13, 2026
- * Last Day of Early-Bird Registration : 9/6, 2026 Extended to 9/13, 2026
- * Announcement of Paper Acceptance : 9/10, 2026 Extended to 9/17, 2026
- * Final Paper Submission Deadline : 9/15, 2026 Extended to 9/22, 2026



Venue

National Central University (NCU)
No.300, Zhongda Rd., Zhongli Dist., Taoyuan City, Taiwan



Version 3 (Updated at 09/03/2026)

SNTCT : <https://www.sntct-eng.org/>
Contact Person : Prof. Po Ting Lin, NTUST, Taiwan
Email : potinglin@mail.ntust.edu.tw
Phone : +886-983-033-147



(FCNDT 2026 Website)

徵稿文件



FCNDT 2026

**第二屆 非破壞檢測技術國際研討會 暨
財團法人台灣非破壞檢測協會年會**

National Central University (NCU)
15-16 October 2026

The 2nd Formosa Conference on Non-Destructive Testing (FCNDT 2026) is organized by the Society for Non-destructive Testing & Certification of Taiwan (SNTCT). FCNDT 2026 will take place in the National Central University. This conference invites professionals from across the industry and academia to actively participate, connect, and collaborate. Please find the detailed information at <https://www.sntct-eng.org/fcndt2026>.



Focus and Scope

Mechanical Engineering	Electronics and Electrical Industry	Aerospace Engineering
Petrochemical Industry	Rail Transportation and Traffic Industry	Advanced Manufacturing
Energy Industry	Infrastructure and Civil Construction	Biomedical Field



Methods and Techniques

Acoustic Emission (AE)	Electromagnetic Testing (ET)	Infrared Testing (IRT)
Leak Testing (LT)	Magnetic Testing (MT)	Penetrant Testing (PT)
Radiographic Testing (RT)	Ultrasonic Testing (UT)	Visual and Optical Testing (VT/OT)
Structural Health Monitoring	Modeling and Simulation	NDT-General
Personnel Training and Certification	Quantitative NDT	Standardization
Wind Turbine (WT)	NDE 4.0 / AI	Biomedical Testing



Submission Guideline and Important Dates

Participants can submit papers for
(a) paper competitions or (b) regular publications.
Each submission could be for
(1) oral presentation or (2) poster presentation.

Guideline of paper length:

- (a1) Oral paper competition: 10–12 pages.
- (a2) Poster paper competition: 2–12 pages.
- (b1) Oral regular paper: 3–12 pages.
- (b2) Poster regular paper: 2–12 pages.

Important Dates:

- * Paper Submission Deadline : 9/6, 2026 *Extended to 9/13, 2026*
- * Last Day of Early-Bird Registration : 9/6, 2026 *Extended to 9/13, 2026*
- * Announcement of Paper Acceptance : 9/10, 2026 *Extended to 9/17, 2026*
- * Final Paper Submission Deadline : 9/15, 2026 *Extended to 9/22, 2026*



Venue

National Central University (NCU)
No.300, Zhongda Rd., Zhongli Dist., Taoyuan City, Taiwan



財團法人台灣非破壞檢測協會
The Society for Nondestructive Testing
& Certification of Taiwan (SNTCT)



國立中央大學
National Central University

SNTCT : <https://www.sntct-eng.org/>
Contact Person : Prof. Po Ting Lin, NTUST, Taiwan
Email : potinglin@mail.ntust.edu.tw
Phone : +886-983-033-147



(FCNDT 2026 Website)

Version 3 (Updated at 09/03/2026)

Conference Venue 會議地點

Conference Venue: Multi-Functional Auditorium, National Central University

Registration Front Desk: 1st Floor of Multi-Functional Auditorium

Address of Conference Venue: 300 Zhongda Rd., Zhongli District, Taoyuan City 320, Taiwan

Banquet Location: New Tao Fang Hall

Address of Banquet Location: No. 19-5, Lane 170, Zhongda Rd., Zhongli District, Taoyuan City 320, Taiwan

會議地點：國立中央大學大禮堂

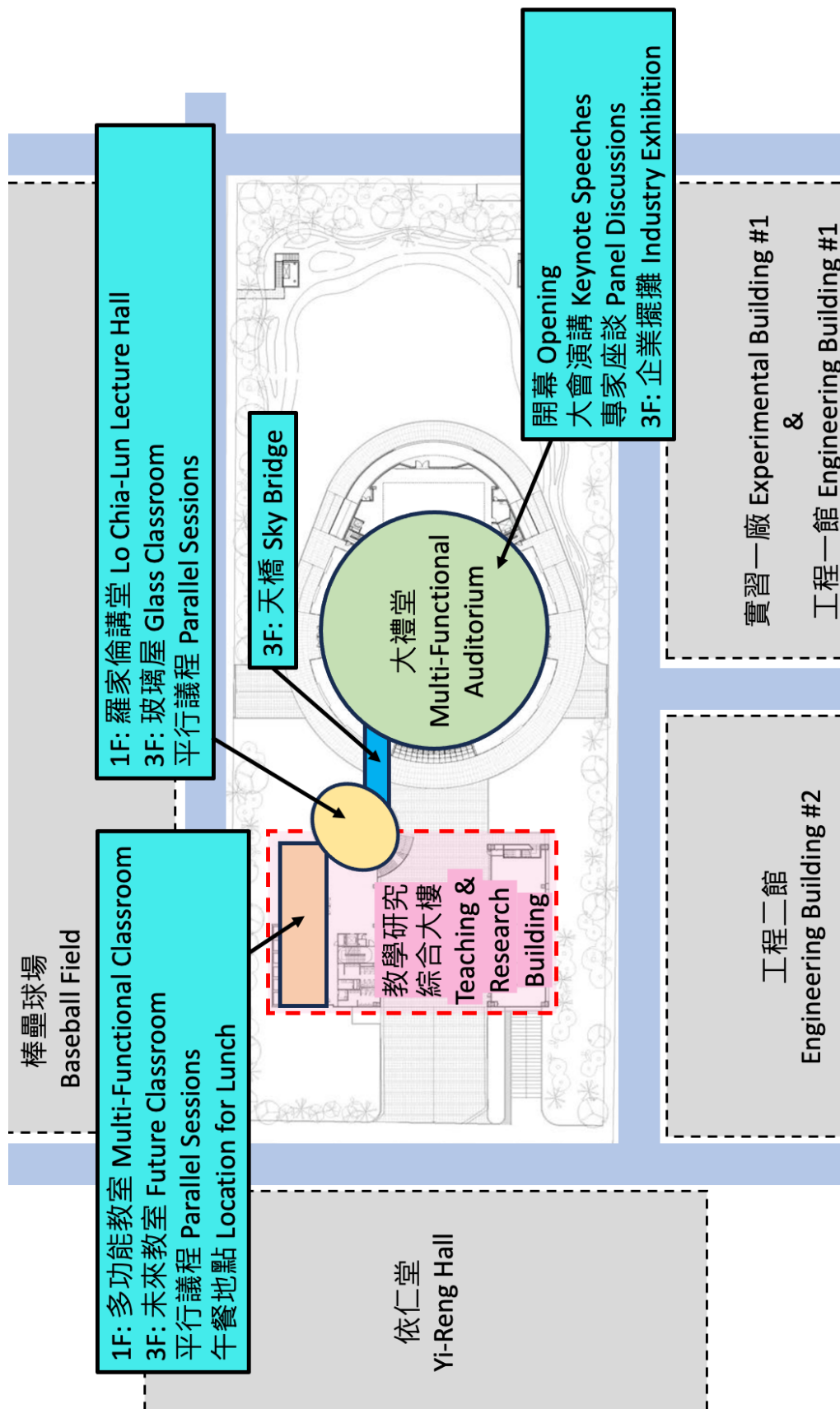
報到處：大禮堂一樓

會議地點地址：320 桃園市中壢區中大路 300 號

晚宴地點：新陶芳庭園餐廳

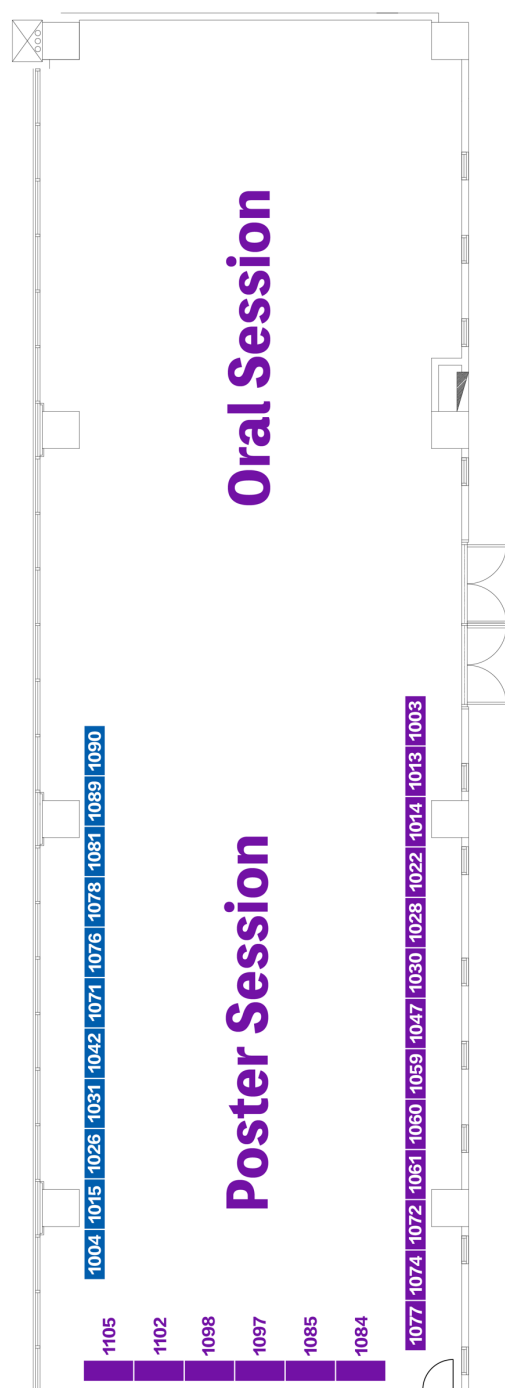
晚宴地址：320 桃園市中壢區中大路 170 巷 19-5 號

Map of Meeting Location 會議地點地圖



Arrangement of Poster Session 海報議程規劃

FCNDT 2026
第二屆 非破壞檢測技術國際研討會 暨
財團法人台灣非破壞檢測協會年會
2nd Formosa Conference on Non-Destructive Testing
National Central University (NCU)
15-16 October 2026
 國立中央大學
 National Central University



Time : 13:00-14:35		★ Competition 競賽
CP: Chinese Poster Session		EP: 英文海報議程
Session Chairs:		主持人:
Ping-Sheng Huang, Jin-Jhy Jeng		黃炳森, 鄭錦智
1003	13:00-13:05	★ 1047
★ 1013	13:05-13:10	1059
1014	13:10-13:15	★ 1060
★ 1022	13:15-13:20	★ 1061
1028	13:20-13:25	1072
1030	13:25-13:30	1074
		1077
		1084
		1085
		★ 1097
		1098
		★ 1102
		1105
		14:00-14:05
		14:05-14:10
		14:10-14:15
		14:15-14:20
		14:20-14:25
		14:25-14:30
		14:30-14:35

Time : 15:12-16:07		★ Competition 競賽
EP: English Poster Session		EP: 英文海報議程
Session Chairs:		主持人:
Ping-Sheng Huang, Jin-Jhy Jeng		黃炳森, 鄭錦智
1004	15:12-15:17	★ 1076
1015	15:17-15:22	★ 1078
1026	15:22-15:27	★ 1081
★ 1031	15:27-15:32	★ 1089
1042	15:32-15:37	★ 1090
1071	15:37-15:42	16:02-16:07

Program at a Glance 議程一覽

		Location 地點						
Date 日期	Time 時間	Auditorium 大禮堂	2F, 3F Auditorium 大禮堂二、三樓	Lo Chia-Lun Lecture Hall 羅家倫講堂	Glass Classroom 玻璃屋	Future Classroom 未來教室	Multi-Functional Classroom 多功能教室	Time 時間
10/15 Thu	8:30-9:30	Registration 註冊						
	9:30-9:50	Opening 開幕式						
	9:50-10:30	PS1: Penary Speech 1 From Safety Assurance to Sustainability Enabler: Redefining the Role of NDT in the Carbon-Neutral Energy Transition Speaker: Dr. Makoto Ochiai Session Chair: Prof. Chih-Hung Chiang PS1: 大會演講 1 演講人: 落合誠博士 主持人: 江支弘教授	Industry Exhibition 企業展覽					
	10:30-10:50		Coffee Break 茶敘					
	10:50-11:30	PS2: Penary Speech 2 AI-HI (Human Intelligence) Integrated NDT and SHM Speaker: Prof. Youho Cho Session Chair: Prof. Yu-Hsi Huang PS2: 大會演講 2 演講人: 趙允浩教授 主持人: 黃育熙教授						
	11:30-12:10	PS3: Penary Speech 3 Evolution and Challenges of Automated Optical Inspection (AOI): From Precision 3D Metrology to AI-Powered Intelligent Inspection for Advanced Semiconductor Packaging Speaker: Prof. Liang-Chia Chen Session Chair: Prof. Ju-Yi Lee PS3: 大會演講 3 演講人: 陳亮嘉教授 主持人: 李朱育教授	Industry Exhibition 企業展覽					
	12:10-13:00				Lunch Time 午餐時間			
				E-S51: Advanced Optical Metrology Session Chair: Hung-Lin Hsieh 英文議程 S51: 先進光學量測技術 主持人: 謝宏麟	E-S52: AI and NDE 4.0 Session Chair: Po Ting Lin 英文議程 S52: 人工智慧與非破壞評估 4.0 主持人: 林柏廷	EC: English Competition Judges: Chih-Hung Chiang, Ching-Chung Yin, Ching-Chi Chen EC: 英文論文競賽 評審: 江支弘, 尹慶中, 陳清祺	CP: Chinese Poster Session Session Chairs: Ping-Sheng Huang, Jin-Jhy Jeng CP: 中文海報議程 主持人: 黃炳森, 鄭錦智	
	13:00-14:20	EF1: Expert Forum 1 Practical Applications of Offshore Wind Power Inspection Session Chair: Vice General Manager Pao-Hung Tong Speakers: Ming-Hung Chang, Shun-Yuan Cheng EF1 專家座談 1: 離岸風電檢測實務 主持人: 童寶鴻副總 引言人: 張明弘、鄭碩元	Industry Exhibition 企業展覽	1011 1027 1036 1049 1073	1017 1040 1041 1112	1023 1045 1056 1065	1003, 1013, 1014, 1022, 1028, 1030, 1047, 1059, 1060, 1061, 1072, 1074, 1077, 1084, 1085, 1097, 1098, 1102, 1105	13:00-13:18 13:18-13:36 13:36-13:54 13:54-14:12
	14:20-14:40		Coffee Break 茶敘	1099		1083 1104	5 min each poster 每篇五分鐘	14:12-14:30 14:30-14:48
	14:40-16:00	EF2: Expert Forum 2 Semiconductor Inspection Technology Session Chair: Dr. Wei-En Fu Speakers: Shih-Hsin Chang, Shao-Yu Chang, Jen-Chieh Wang, Chia-Che Hsieh, Gaurav Pandey EF2 專家座談 2: 半導體檢測技術 主持人: 傅尉恩博士		C-S51: Advanced Optical Metrology Session Chair: Kun-Huang Chen 中文議程 S51: 先進光學量測技術 主持人: 陳坤煌	C-S57: Civil NDT Session Chair: Keng-Tsang Hsu 中文議程 S57: 土木非破壞檢測 主持人: 許秋奮	CC: Chinese Competition Judges: Chih-Hung Chiang, Ching-Chung Yin, Ching-Chi Chen CC: 中文論文競賽 評審: 江支弘, 尹慶中, 陳清祺	EP: English Poster Session Session Chairs: Ping-Sheng Huang, Jin-Jhy Jeng EP: 英文海報議程 主持人: 黃炳森, 鄭錦智	15:12-15:30 15:30-15:48
	16:00-17:20	EF3: Expert Forum 3 CNS Maintenance and Non-Destructive Testing Personnel Qualification Verification Implementation Session Chair: General Manager Yung-Shun Su Speakers: P.K. Chen, Kent Cheng EF3 專家座談 3: CNS維護及非破壞檢測人員資格驗證 主持人: 蘇詠賢總經理 引言人: 陳必貴、鄭靖洲	Industry Exhibition 企業展覽	1005 1008 1016 1093 1107 1109	1007 1032 1082 1086 1096	1037 1038 1052 1055 1087 1100	1004, 1015, 1026, 1031, 1042, 1071, 1076, 1078, 1081, 1089, 1090,	15:48-16:06 16:06-16:24 16:24-16:42 16:42-17:00
	17:20-18:00	Moving to Banquet Venue 移動至晚宴場地						
	18:00-20:00	Banquet 晚宴: New Tao Fang Hall 新陶芳庭宴廳						

	Transportation 移動
	Meal 用餐
	Plenary Speech 大會演講
	Expert Forum 專家座談
	Industry Exhibition 企業展覽
	Chinese Session 中文議程
	English Session 英文議程

		Location 地點						
Date 日期	Time 時間	Auditorium 大禮堂	2F, 3F Auditorium 大禮堂二、三樓	Lo Chia-Lun Lecture Hall 羅家倫講堂	Glass Classroom 玻璃屋	Future Classroom 未來教室	Multi-Functional Classroom 多功能教室	Time 時間
10/16 Fri	10:10-10:50	PS4: Penary Speech 4 AI in Quantitative Laser Ultrasound Visualization Technique Speaker: Prof. Che-Hua Yang Session Chair: Prof. Ching-Chun Yin PS4: 大會演講 4 演講人: 楊哲化教授 主持人: 尹慶中教授	Industry Exhibition 企業展覽					
	10:50-11:20		Coffee Break 茶敘					
	11:20-12:00	PS5: Penary Speech 5 Metastructure for Nonlinear Ultrasonic Higher Harmonic Elimination Speaker: Prof. Jaesun Lee Session Chair: Prof. Chin-Chi Chen PS5: 大會演講 5 演講人: 李宰先教授 主持人: 陳清祺教授	Industry Exhibition 企業展覽					
	12:00-13:00				Lunch Time 午餐時間			
				E-S54: Advanced Electromagnetic Testing Session Chair: Yu-Ching Lee 英文議程 S54: 先進電磁測試 主持人: 李雨青	E-R1: Advanced NDT Technologies and Applications Session Chair: Chan-Yi Liao 英文議程 R1: 先進非破壞檢測與應用 主持人: 廖展龍	E-R2: Metrology Session Chair: Ju-Yi Lee 英文議程 R2: 量測 主持人: 李朱育	C-S52: AI and NDE 4.0 Session Chair: Po Ting Lin 中文議程 S52: 人工智慧與非破壞評估 4.0 主持人: 林柏廷	
	13:00-14:20	EF4: Expert Forum 4 Development and Application of Nondestructive Testing (NDT) Technologies in Power Plant Decommissioning and Re-operation Session Chair: Dr. Kuang-Chih Pei Speakers: Jen-Hung Chen, D.W. Lin, Hung-Fa Shyu, Ilham Mukriz Zainal Abidin, Yaw-Hwa Shiu EF4 專家座談 4: 非破壞檢測技術在電廠除役及再運轉之發展與應用 主持人: 廖廣智博士 引言人: 陳仁宏、林東威、徐鴻發、Ilham Mukriz Zainal Abidin、黃耀華	Industry Exhibition 企業展覽	Invited Talk 1: 1091 Invited Talk 2: 1110 1024 1035 1075	1006 1025 1044 1058 1070 1088	1046 1062 1068 1079 1080	1048 1050 1051 1054 1063 1092	13:00-13:18 13:18-13:27 13:27-13:36 13:36-13:54 13:54-14:12 14:12-14:30 14:30-14:48 14:48-15:12
	14:20-14:40		Coffee Break 茶敘					
	14:40-16:00	EF5: Expert Forum 5 Development of NDT Applications for Steel Structures Session Chair / Speaker: Dr. Peng-Chi Peng EF5 專家座談 5: 鋼結構 NDT 應用發展 主持人/引言人: 彭朋龍博士 引言人: 吳峻傑、姬俊宇、余金貴、劉松明	Industry Exhibition 企業展覽	C-S56: Inspection for Nuclear Power Plants Session Chair: Joe-Ming Chang 中文議程 S56: 核電廠檢測 主持人: 張佐民	C-R1: Ultrasonic Testing (UT) Session Chair: Wen-Chuan Wu 中文議程 R1: 超音波檢測 主持人: 吳文詮	C-S53: Guided Wave NDT Session Chair: Ping Hung Lee 中文議程 S53: 導波非破壞檢測 主持人: 李東鴻	C-S55: Advanced Vibration Testing Session Chair: Chan-Yi Liao 中文議程 S55: 先進振動測試 主持人: 廖展龍	15:12-15:30 15:30-15:48 15:48-16:06 16:06-16:24 16:24-16:42 16:42-17:00
				1053 1057 1064 1069 1095 1108	1002 1009 1010 1034 1066	1101 1103 1106 1111	1010 1012 1029 1043 1094	

Program Schedule 研討會議程表

10/15/2026 Thursday 星期四					
Time 時間	Session 議程	Title 演講題目	Chair/Speaker 主 持人/演講人/作 者	Location 地點	Page 頁數
8:30- 9:30	Registration 報到			1F Auditorium 大禮堂一樓	
9:30- 9:50	Opening 開幕式			Auditorium 大禮堂	
9:50- 10:30	PS1: Plenary Speech 1 大會演講 1	From Safety Assurance to Sustainability Enabler: Redefining the Role of NDT in the Carbon- Neutral Energy Transition	Speaker: Dr. Makoto Ochiai Session Chair: Prof. Chih-Hung Chiang 演講人: 落合誠 博士 主持人: 江支弘 教授		37
10:30- 10:50	Coffee Break 茶敘			2F,3F Auditorium 大禮堂二, 三樓	
10:50- 11:30	PS2: Plenary Speech 2 大會演講 2	AI-HI (Human Intelligence) Integrated NDT and SHM	Speaker: Prof. Younho Cho Session Chair: Prof. Yu-Hsi Huang 演講人: 趙允浩 教授 主持人: 黃育熙 教授	Auditorium 大禮堂	39
11:30- 12:10	PS3: Plenary Speech 3 大會演講 3	Evolution and Challenges of Automated Optical Inspection (AOI): From Precision 3D Metrology to AI-Powered Intelligent Inspection for Advanced Semiconductor Packaging	Speaker: Prof. Liang-Chia Chen Session Chair: Prof. Ju-Yi Lee 演講人: 陳亮嘉 教授 主持人: 李朱育 教授		41

10/15/2026 Thursday 星期四

Time 時間	Session 議程	Title 演講題目	Chair/Speaker 主 持人/演講人/作 者	Location 地點	Page 頁數
12:10- 13:00	Lunch Time 午餐時間			Multi- Functional Classroom 多功能教室	
13:00- 14:20	EF1: Expert Forum 1 專家座談 1	Practical Applications of Offshore Wind Power Inspection 離岸風電檢測實務	Session Chair: Vice General Manager Pao- Hung Tong Speakers: Ming- Hung Chang, Shun-Yuan Cheng 主持人: 董寶鴻 副總 引言人: 張明 弘、鄭順元	Auditorium 大禮堂	47
13:00- 14:48	E-SS1: Advanced Optical Metrology 英文議程 SS1: 先進光學量測 技術	Session Chair: Hung-Lin Hsieh 主持人: 謝宏麟		Lo Chia- Lun Lecture Hall 羅家倫講堂	97
		1011	Radially Polarized Beam-Based Dual- Wavelength Interferometry for Surface Profile Measurement Tzu-Hsiang Chang, Cheng- Che Hsieh, Jing- Heng Chen, Kun- Huang Chen		
		1027	Large-Area Wafer Surface Topography Measurement Based on Shadow Moiré and Spatial Averaging Yan-Cheng Hu, Wei Chen, Ting- Hao Cao, Ju-Yi Lee		
		1036	Measurement Performance of Reflector-Aided LiDAR Localization for a High-Payload Autonomous Mobile Robot Chen-Fei Yang, Yi-Chuan Tseng, Po Ting Lin		

10/15/2026 Thursday 星期四

Time 時間	Session 議程	Title 演講題目		Chair/Speaker 主 持人/演講人/作 者	Location 地點	Page 頁數
		1049	Application of a Fizeau Interferometer Based on Electro-Optic Modulation and Error-Suppressed Phase Demodulation for Wafer Surface Topography Measurement	Jia-Ying Li, Yu-Yi Hsieh, Hung-Lin Hsieh		
		1073	Polarization-Multiplexed Single-Shot Dual-Wavelength Lens-Free Holographic Imaging	Chung-Hsuan Huang, Chau-Jern Cheng, Han-Yen Tu		
		1099	In-Plane Displacement Measurement Using a Reflective Grating Interferometer	Kun-Huai Shen, Chun-Pin Chen, Hung-Lin Hsieh		
13:00-14:12	E-SS2: AI and NDE 4.0 英文議程 SS2: 人工智慧與非破壞評估 4.0	Session Chair: Po Ting Lin 主持人: 林柏廷			Glass Classroom 玻璃屋	103
		1017	Experimental Assessment and LS-DYNA Validation of Auto-injector Drop-Impact Response	Hariyanto Gunawan, Hsing-Yu Chen, Pei-Chun Chen, AM Mufarrih		
		1040	Vision-Language-Assisted Open-Vocabulary Recognition and 3D Measurement for Robotic Inspection	Lin-Shang Pan, Chii Hong Liu, Po Ting Lin		
		1041	AI-Accelerated Virtual Dynamic Stability Assessment of Palletized Loads Using a Graph Network Surrogate Model	Jiong-Wei Lin, Ching-Fa Wu, Po Ting Lin, Chyi-Yeu Lin		

10/15/2026 Thursday 星期四

Time 時間	Session 議程	Title 演講題目		Chair/Speaker 主 持人/演講人/作 者	Location 地點	Page 頁數
		1112	IMU-Assisted Optical Flow Video Stabilization for Enhanced AI-DIC Drone for SHM of Large Structures	Jayanth Gowda B V, Sneha Prasad, Paaesee Rai, Rohan Kishor Nakade, David Kumar, Chih- Hung Chiang		
13:00- 14:48	EC: English Competition EC: 英文論文 競賽	Judges: Chih-Hung Chiang, Ching-Chung Yin, Ching-Chi Chen 評審: 江支弘, 尹慶中, 陳清祺			Future Classroom 未來教室	60
		1023	Design of a Yoke- Type Eddy Current Sensor for Crack Detection in Metals	Yu-An Chen, Chun-Yeon Lin		
		1045	Aerospace Turbine Blade Defect Detection Using Machine Vision and Balanced Feature Fusion	Yi-Kai Chao, Jing-Feng Weng		
		1056	Feasibility of Point Cloud Reconstruction for Wind Turbine Blades from Unplanned Drone Video: A COLMAP Parameter Sensitivity Study	Mahesh, Liu-Chao Hsien, Wei-Long Chen, Yung- Chiang Lin, David Kumar, Sneha Prasad, Chih-Hung Chiang		
		1065	Low-Cost Acoustic Non-Destructive Evaluation using 3D-printed Stethoscope Probe	Aufa Ulin Nuha, Yin Jui Tseng, Jung Ting Tsai		
		1083	Anomaly Detection of Tipping Bucket Rain Gauges Using a Machine Learning Model with Multi- Domain Vibration Signal Features	Ting-Yu Chien, Chin-Ho Liu, Shang-Chih Lin, Shun-Feng Su, Yennun Huang		

10/15/2026 Thursday 星期四

Time 時間	Session 議程	Title 演講題目		Chair/Speaker 主 持人/演講人/作 者	Location 地點	Page 頁數
		1104	Optimizing Lock-in Thermography for Reliable Defect Detection in Thermal Barrier Coatings	Jiwon Park, Jonghwan Park, Yeongil Choi, Hunhee Kim, Do- Kyung Pyun, Jaesun Lee		
13:00- 14:35	CP: Chinese Poster Session CP: 中文海報 議程	Session Chairs: Ping-Sheng Huang, Jin-Jhy Jeng 主持人: 黃炳森, 鄭錦智			Multi- Functional Classroom 多功能教室	72
		1003	電弧效應的生成與對材料組織的影響	陳奕成, 鄭銘文		
		1013	傳統超音波檢測與相位陣列超音波檢測技術比較及其於焊道缺陷檢測之應用	陳偉譯, 郭韋凡, 郭金龍, 黎家銘, 鄭偉凡		
		1014	中鋼新建煉焦爐工程非破壞檢測作業	黃伯揚		
		1022	基於 VGG19 深度學習模型之 ASME SA213-T12 鍋爐鋼金相複製膜影像分類	高全盛, 孫千茹, 陳雨玟		
		1028	傳統遠場渦電流與陣列式遠場渦電流於支撐板鄰近瑕疵之判別差異	余坤城, 陳明書, 袁翊峻		
		1030	用於即時偵測車輛前照度的高動態成像系統	吳啓守, 林士罡, 蕭力瑋, 阮光鈞, 楊宗勳, 余業緯, 孫慶成		
		1047	基於實際 Twyman-Green 干涉圖之曲率半徑深度學習估測：不同卷積神經網路架構之比較	柯昱宏, 田春林, 黃翌宸		
		1059	熱交換管頻率選擇及評估方式之探討	鍾明雄, 陳秀易, 葉嘉興		

10/15/2026 Thursday 星期四

Time 時間	Session 議程	Title 演講題目		Chair/Speaker 主 持人/演講人/作 者	Location 地點	Page 頁數
		1060	被動式乾貯鋼筒腐蝕指示器的研發與應用	張佐民, 蔡坤釗, 董曉明, 葉俊平		
		1061	電磁超音波應用於超超臨界鍋爐水牆管材質劣化檢測	林士瑄, 高全盛, 林宏儒, 黃鴻鈞, 蔡武哲		
		1072	結合振動響應量測與高速影像分析之顆粒阻尼懸臂梁減振特性研究	沈立宗, 戴棟文		
		1074	多維度聲音地圖建構之關鍵前端技術研究	謝佳妤, 沈志雄		
		1077	以全反射渦旋光干涉術測量液體折射率	歐家安, 張蚊綺, 林俊佑, 沈志雄		
		1084	非監督式物理資訊神經網路於定量雷射超音波之缺陷評估	葉祐良, 楊哲化, 郭育誠		
		1085	聲波辨識應用於鋅線技術金/銅異質鍵合之研究	葉雲鵬, 廖柏宇		
		1097	鈹銅複合材料模具對射出成型冷卻時間之影響	黃建勝, 陳夏宗, 丁郁宏, 鄭年添, 施宥恩, 陳勁豪, 王祥瑋		
		1098	發電鍋爐保溫下腐蝕檢測技術建立與應用	洪敬傑, 翁德富		
		1102	基於損耗模態共振製作鍍膜光纖 CO2 氣體感測器	黃翌宸, 田春林, 柯昱宏		

10/15/2026 Thursday 星期四

Time 時間	Session 議程	Title 演講題目		Chair/Speaker 主 持人/演講人/作 者	Location 地點	Page 頁數
		1105	基於七點三次自適應峰值定位之共光軸條紋投影非接觸式三維表面形貌量測	Rui-Hong Hong, Bo-Hao Huang, Nai-Jen Cheng		
14:20- 15:12	Coffee Break 茶敘				2F,3F Auditorium 大禮堂二, 三樓	
14:40- 16:00	EF2: Expert Forum 2 專家座談 2	Semiconductor Inspection Technology 半導體檢測技術		Session Chair: Dr. Wei-En Fu Speakers: Shih- Hsin Chang, Shao-Yu Chang, Jen-Chieh Wang, Chia-Che Hsieh, Gaurav Pandey 主持人: 傅尉恩 博士	Auditorium 大禮堂	49
15:12- 17:00	C-SSI: Advanced Optical Metrology 中文議程 SSI: 先進光學量測 技術	Session Chair: Kun-Huang Chen 主持人: 陳坤煌			Lo Chia- Lun Lecture Hall 羅家倫講堂	113
		1005	多光源的電鍍工件刮痕檢測系統開發	周品好, 李維楨		
		1008	應用於奈米粒子追蹤分析之 FPGA 雙尺度高斯差分即時前處理架構	周彥廷, 何昭慶, 蘇詠靖		
		1016	基於 YOLOv11 之碳纖維表面多缺陷影像辨識研究	張家源, 劉建宏		
		1093	超穎表面結構之全光繞射神經網路應用於高速影像辨識技術研究	楊曼岑, 沈志雄		
		1107	反光金屬零件之雙視角輪廓精修六自由度姿態估測	范潤洋, 林錦德		

10/15/2026 Thursday 星期四

Time 時間	Session 議程	Title 演講題目		Chair/Speaker 主 持人/演講人/作 者	Location 地點	Page 頁數
		1109	感測頭熱穩定性對 紅外高溫計測溫精 準度之影響	康皓宇, 邱政斌, 陳玉彬		
15:12- 16:42	C-SS7: Civil NDT 中文議程 SS7: 土木非破壞檢 測	Session Chair: Keng-Tsang Hsu 主持人: 許耿蒼			Glass Classroom 玻璃屋	135
		1007	船用減速機冷卻器 管渦電流檢測	林財得, 許家逢, 柳彥祺		
		1032	PAUT、TOFD、 TFM、PCI 對於鉀 道瑕疵方向性檢出 能力探討	黎家銘, 黃啟貞, 黃炳森, 郭榆承, 陳煜琦, 邱雍惟, 曾科毓		
		1082	利用格雷碼結合四 步相移方法於珊瑚 三維量測研究	陳又維, 蕭涵翊, 溫博浚		
		1086	以紅外線熱影像技 術評估螺栓結合狀 況之初步研究	許耿蒼, 廖偉丞, 黃丞頤		
		1096	多元監檢測技術於 堤岸防汛道路安全 監測之實務應用	許耿蒼, 洪嘉鍵, 張昀萱		
15:12- 17:00	CC: Chinese Competition CC: 中文論文 競賽	Judges: Chih-Hung Chiang, Ching-Chung Yin, Ching-Chi Chen 評審: 江支弘, 尹慶中, 陳清祺			Future Classroom 未來教室	67
		1037	應用於手腕橈動脈 脈搏波量測之壓電 感測器結構設計與 訊號特性分析	林凱芸, 黃育熙		
		1038	車用齒輪箱變速工 況振動訊號特徵擷 取與故障診斷	張瑋翔, 黃鈺晶, 吳育仁		
		1052	雙相多疊層結構黏 結品質非破壞檢測 技術開發	陳建穎, 楊哲化, 王睿謙		
		1055	基於 Field II 可控次 諧波散射體模擬之 超音波定量特徵穩 健性評估與排序	林皇辰		

10/15/2026 Thursday 星期四

Time 時間	Session 議程	Title 演講題目		Chair/Speaker 主 持人/演講人/作 者	Location 地點	Page 頁數
		1087	廣義疊加分段理論 分析複雜幾何連接 板之面內動態行為 與驗證	許建核, 李維哲, 吳亦莊		
		1100	基於分佈式光纖聲 學感測(Distributed Acoustic Sensing, DAS)系統之船錨事 件聲紋量測方法	顏汝珊, 林庭寬, 洪裕涵		
15:12- 16:07	EP: English Poster Session EP: 英文海報 議程	Session Chairs: Ping-Sheng Huang, Jin-Jhy Jeng 主持人: 黃炳森, 鄭錦智			Multi- Functional Classroom 多功能教室	86
		1004	AI-Based Weld Defect Classification from Ultrasonic A- Scan Images: Taguchi Optimization	Yi-Min Lai, Zong-Jun Wu, Yu-Hsuan Lin, Cheng-Feng Wang, Ming-Che Lin		
		1015	Allan Deviation- Based Optimization of Sensor Signal Processing for Optical Gas Measurement	Yu-Cheng Lin, An-Chi Wei, Jyh- Rou Sze		
		1026	Improving Ultrasonic Inspection Reliability of As- built WAAM Components with Rough Surfaces Using Solid Composite Couplants	Shang-Pang Yu, Pei-Gang Tong		
		1031	Wide-Angle Edge Detection Metasurface for Infrared with Hexagonal Arrangement	Po-Yu Wu, Chun- Yuan Fan		

10/15/2026 Thursday 星期四

Time 時間	Session 議程	Title 演講題目	Chair/Speaker 主 持人/演講人/作 者	Location 地點	Page 頁數
		1042 LocAu-PS Microarrays with Wettability-Driven Droplet Confinement and Optimized SERS Hot-Spots for Micro-Volume Bioanalysis	Jung-Yen Hsu, Chia-Wen Tsao, Nai-Jen Hung		
		1071 Measurement and Evaluation of Wavelength- Dependent Imaging Aberrations in Line- Image Holograms	Pin-Cheng Lin, Min-Hsin Chan, Bo-Siang Jhong, Cheng-Ting Huang, Jing-Heng Chen		
		1076 Automated wide- field imaging in lens-free digital holography	Chih-Cheng Hsu, Chung-Hsuan Huang, Chau-Jern Cheng, Han-Yen Tu		
		1078 Effect of Surface Morphology on the Optimal Polishing Depth in SiO ₂ Abrasive Polishing of Rough Silicon Wafers: A Molecular Dynamics Study	Minheon Chu, Sungmin Yoon		
		1081 Axial Depth Position Mapping in Coaxial Shallow-Depth-of- Field Fringe Projection Based on Phase-Partitioned Focus Determination	Tzu-Chun Lin, Bo-Hao Huang, Nai-Jen Cheng, Wei-Hung Su		
		1089 A Data Driven Framework for Frequency Dependent Insertion Loss Prediction and Acoustic Material Screening	Jonghwan Park, Boris I, Jiwon Park, Do-Kyung Pyun, Jaesun Lee		

10/15/2026 Thursday 星期四

Time 時間	Session 議程	Title 演講題目		Chair/Speaker 主 持人/演講人/作 者	Location 地點	Page 頁數
		1090	Mode III Fracture Mechanics Parameters Measurement of 3D- Printing Structures using Optical Interferometry	Po-Yuan Kuo, Jiong-Shiun Hsu		
16:00- 17:20	EF3: Expert Forum 3 專家座談 3	CNS Maintenance and Non-Destructive Testing Personnel Qualification Verification Implementation CNS 維護及非破壞檢測人 員資格驗證執行		Session Chair: General Manager Yung-Shun Su Speakers: P.K. Chen, Kent Cheng 主持人: 蘇詠舜 總經理 引言人: 陳必貫, 鄭靖洲	Auditorium 大禮堂	52
17:20- 18:00	Moving to Banquet Venue 移動至晚宴場地					
18:00- 20:00	Banquet 晚宴: New Tao Fang Hall 新陶芳庭園餐廳					

10/16/2026 Friday 星期五

Time 時間	Session 議程	Title 演講題目	Chair/Speaker 主 持人/演講人/作 者	Location 地點	Page 頁 數
10:10- 10:50	PS4: Plenary Speech 4 大會演講 4	AI in Quantitative Laser Ultrasound Visualization Technique	Speaker: Prof. Che-Hua Yang Session Chair: Prof. Ching- Chun Yin 演講人: 楊哲化 教授 主持人: 尹慶中 教授	Auditorium 大禮堂	43
10:50- 11:20	Coffee Break 茶敘			2F,3F Auditorium 大禮堂二, 三樓	
11:20- 12:00	PS5: Plenary Speech 5 大會演講 5	Metastructure for Nonlinear Ultrasonic Higher Harmonic Elimination	Speaker: Prof. Jaesun Lee Session Chair: Prof. Ching-Chi Chen 演講人: 李宰先 教授 主持人: 陳清祺 教授	Auditorium 大禮堂	45
12:10- 13:00	Lunch Time 午餐時間			Multi- Functional Classroom 多功能教 室	

10/16/2026 Friday 星期五

Time 時間	Session 議程	Title 演講題目	Chair/Speaker 主 持人/演講人/作 者	Location 地點	Page 頁 數
13:00- 14:20	EF4: Expert Forum 4 專家座談 4	Development and Application of Nondestructive Testing (NDT) Technologies in Power Plant Decommissioning and Re- operation 非破壞檢測技術在電廠除 役及再運轉之發展與應用	Session Chair: Dr. Kuang-Chih Pei Speakers: Jen- Hung Chen, D.W. Lin, Hung- Fa Shyu, Ilham Mukriz Zainal Abidin, Yaw- Hwa Shiu 主持人: 裴廣智 博士 引言人: 陳仁 宏、林東威、徐 鴻發、Ilham Mukriz Zainal Abidin、胥耀華	Auditorium 大禮堂	54
13:00- 14:48	E-SS4: Advanced Electromagnetic Testing 英文議程 SS4: 先進電磁測試	Session Chair: Yu-Ching Lee 主持人: 李雨青		Lo Chia- Lun Lecture Hall 羅家倫講 堂	108
		1091 Invited Talk 13:00- 13:27	Wave characteristics of magneto-electro- elastic laminates with imperfect interfaces Yun-Hsuan Wang, Kuang- Hung Wei, Hsin- Yi Kuo		58
		1110 Invited Talk 13:27- 13:54	Stress Position Detection Using Magnetoelastic Stray Magnetic Fields for Early Diagnosis of Industrial Structures Gye Jo Jung		
		1024	Low-frequency stretching force measurement of framed membranes Yu-Ching Lee, Chun-Jui Hsu		108

10/16/2026 Friday 星期五

Time 時間	Session 議程	Title 演講題目		Chair/Speaker 主 持人/演講人/作 者	Location 地點	Page 頁 數
		1035	Development and Application of Horizontally Polarized Guided Wave Electromagnetic Acoustic Transducer	Wen-Chuan Wu, Dun-Ning Zhang, Ching-Chung Yin		
		1075	Guided-Wave Electromagnetic Acoustic Transducers: A Comprehensive Review	Ching-Chung Yin, Wen-Chuan Wu		
13:00-14:48	E-R1: Advanced NDT Technologies and Applications 英文議程 R1: 先進非破壞檢測與應用	Session Chair: Chan-Yi Liao 主持人: 廖展誼			Glass Classroom 玻璃屋	139
		1006	Advanced Ultrasound Methods for HTHA Inspection	Dennis Chai, Stéphan Couture		
		1025	Fluid-Structure Coupled Dynamic Response of a Partially Submerged Plate Subjected to an Underwater Spark Discharge Wave Source	Hao-Chun Ho, Chan-Yi Liao		
		1044	Integrated Real-Time Diagnosis of Phase Changes in Freeze-Drying Using Ultrasonic Transducers and Optical Methods	Chin-Chi Cheng, Chien-An Lin, Zhe-Rui Liu, Shih-Chang Huang, Jing-Xuan Huang, Hong-Ping Cheng		

10/16/2026 Friday 星期五

Time 時間	Session 議程	Title 演講題目		Chair/Speaker 主 持人/演講人/作 者	Location 地點	Page 頁 數
13:00- 14:30		1058	A Handheld Spherical Sensor for Multidirectional NDT Surface Inspection with Machine Learning-Based Classification	Edmun Iro Kavallo Halawa, Wei-Song Hung, Po Ting Lin		
		1070	Single-Shot Polarization Interferometry with Enhanced Sampling Density for Optical Surface Profile Measurement	Hsing-Hsien Tsai, Ju-Yi Lee		
		1088	FEA Based Sensor Placement and Long Term Acoustic Emission Monitoring of A Large Structure	Jonghwan Park, Suksan Ok, Yeongil Choi, Do-Kyung Pyun, Jaesun Lee		
	E-R2: Metrology 英文議程 R2: 量 測	Session Chair: Ju-Yi Lee 主持人: 李朱育			Future Classroom 未來教室	146
		1046	Rotation Angle Measurement Using A Holographic Radial Grating with Heterodyne Interferometry	Chun-Yi Chang, Che-An Yang, Ju-Yi Lee, Cheng-Chih Hsu		
		1062	Measurement of the Refractive Index of Prism with the Maximum Phase Difference of Total-Internal Reflection and Polarization Camera	Yi-Ying Lin, Tzu-Mo Lee, Chia-Yu Chiang, Ju-Yi Lee		

10/16/2026 Friday 星期五

Time 時間	Session 議程	Title 演講題目		Chair/Speaker 主 持人/演講人/作 者	Location 地點	Page 頁 數
13:00- 14:48		1068	Measurement of Roll Angular Displacement Using Dual-Beam Polarization Interferometry	Shang-Wei Cai, Ching-Tse Hsu, Shu-Han Chang, Wun-Yan Chen, Ju-Yi Lee		
		1079	Surface Topography Measurement Based on Polarization Interferometry	Tzu-Mo Lee, Wun-Yan Chen, Yue-Jhe Tsai, Ju- Yi Lee		
		1080	Instantaneous Wave Plate Measurement with Phase Retardation and Fast Axis Azimuth	Wei Chen, Wei- Cheng Wong, Chia-Yu Chung, Ju-Yi Lee		
	C-SS2: AI and NDE 4.0 中文議程 SS2: 人工智慧與非破 壞評估 4.0	Session Chair: Po Ting Lin 主持人: 林柏廷			Multi- Functional Classroom 多功能教 室	118
		1048	基於正例－未標 記學習與極端隨 機樹集成多波束 聲納目標濾波之 魚群監測研究	梁育翔, 盧光輝, 李明安, 溫博浚		
		1050	人工智慧於積層 製造非均勻材料 性質之預測	黃宇綻, 楊哲化, 蔡官邑		
		1051	利用神經算子物 理一致性及蘭姆 波頻散於機械性 質之反算	蘇彥宇, 楊哲化, 李育緯		
		1054	結合人工智慧材 料常數識別之無 人機複合材料結 構老化評估與壽 命預測	劉警文, 金大仁		

10/16/2026 Friday 星期五

Time 時間	Session 議程	Title 演講題目		Chair/Speaker 主 持人/演講人/作 者	Location 地點	Page 頁 數
		1063	以時序列印參數 與流變性質之深 度學習預測生物 支架線徑研究	蘇暉凱, 曾偉智, 楊程軒, 廖昭仰		
		1092	石化產業鐳道射 線檢測影像之 人 工智慧輔助缺陷 辨識	林榮讚, 張啓瑞, 吳紹琪, 吳郁君		
14:20- 15:12	Coffee Break 茶敘				2F,3F Auditorium 大禮堂二, 三樓	
14:40- 16:00	EF5: Expert Forum 5 專家座談 5	Development of NDT Applications for Steel Structures 鋼結構 NDT 應用發展		Session Chair / Speaker: Dr. Peng-Chi Peng 主持人/引言人: 彭朋畿博士 引言人: 吳峻傑, 姬俊宇, 余金賢, 劉松明	Auditorium 大禮堂	56
15:12- 17:00	C-SS6: Inspection for Nuclear Power Plants 中文議程 SS6: 核 電廠檢測	Session Chair: Joe-Ming Chang 主持人: 張佐民			Lo Chia- Lun Lecture Hall 羅家倫講 堂	130
		1053	核電廠除役過渡 階段碳鋼管材腐 蝕行為研究	呂文豐, 蔡坤釗		
		1057	模擬乾式貯存實 驗後用過核子燃 料護套完整性之 非破壞檢驗	謝堯瀚		
		1064	美國 IPEC 之燃料 池外牆滲漏案例 研析	張佐民, 呂文豐		
		1069	美國 Palisades 核 電廠重啟檢測之 蒸汽產生器管路 破損案例研析	張佐民, 呂文豐		

10/16/2026 Friday 星期五

Time 時間	Session 議程	Title 演講題目		Chair/Speaker 主 持人/演講人/作 者	Location 地點	Page 頁 數
		1095	核電廠乾式貯存 密封鋼筒銲接之 非破壞檢測作業	李建洲		
		1108	以中子繞射方法 研究銅質材料腐 蝕行為	雍敦元, 呂文豐, 蔡坤釗, 李文献		
15:12- 16:42	C-R1: Ultrasonic Testing (UT) 中文議程 R1: 超 音波檢測	Session Chair: Wen-Chuan Wu 主持人: 吳文銓			Glass Classroom 玻璃屋	151
		1002	利用 ADTTU 檢 測技術進行複材 內部缺陷偵測研 究	陳世峯, 蕭天文		
		1009	天然氣電廠熱回 收鍋爐汽鼓銲道 相位陣列超音波 檢測	陳豪韋, 李任翔, 蘇兩傳		
		1018	陣列式超音波全 聚焦法 (PAUT- TFM) 於卸船機 液壓桿環形鉤檢 測之應用	楊智詠, 邱柏誠		
		1034	離岸風電管架銲 接橫向裂縫問題 改善經驗	董寶鴻		
		1066	TFM 與 PCI 檢測 技術之功能驗證 與設定	郭佳揚, 黃啟貞		
15:12- 16:24	C-SS3: Guided Wave NDT 中文議程 SS3: 導波非破壞檢測	Session Chair: Ping Hung Lee 主持人: 李秉鴻			Future Classroom 未來教室	123
		1101	導波監測系統於 管線腐蝕預警之 能力評估	李秉鴻, 余國禎, 朱民宏, 林建凱, 陳漢昕, 王俊傑, 李尚樺		
		1103	基於導波模態共 振之快速測厚與 腐蝕成像研究	李秉鴻, 蔡建安, 李志杰, 杜權家, 陳昕, 宋泓慶		

10/16/2026 Friday 星期五

Time 時間	Session 議程	Title 演講題目		Chair/Speaker 主 持人/演講人/作 者	Location 地點	Page 頁 數
		1106	以高頻導波檢測 不銹鋼管點蝕能 力之研究	李秉鴻, 佘國禎, 朱民宏, 林建凱, 陳漢昕		
		1111	基於機器學習之 熱交換管渦電流 檢測缺陷辨識系 統開發	吳維勁, 古運承, 廖駿偉		
15:12- 16:42	C-SS5: Advanced Vibration Testing 中文議程 SS5: 先 進振動測試	Session Chair: Chan-Yi Liao 主持人: 廖展誼			Multi- Functional Classroom 多功能教 室	126
		1010	單一板型試片之 壓電材料常數混 合式反算方法	林育廷, 黃育熙		
		1012	鋼珠撞擊與壓電 陶瓷激振下自由 邊界圓板與短圓 柱之振動特性量 測	蘇于琪, 劉有晟, 翁珮旋		
		1029	曲率可控的動態 光纖位移感測器	莊國志		
		1043	壓電機器人設計 與性能實驗分析	林育志, 馮聖皓, 陳冠霖, 謝睿祺		
		1094	基於振動訊號與 深度學習之 6061 鋁合金微孔加工 品質非破壞評估	郭瀚聲, 何青原, 林冠廷		

PS1: Plenary Speech 1, 大會演講 1

From Safety Assurance to Sustainability Enabler: Redefining the Role of NDT in the Carbon-Neutral Energy Transition

Speaker: Dr. Makoto Ochiai

Session Chair: Prof. Chih-Hung Chiang

演講人: 落合誠博士

主持人: 江支弘教授

Time 時間：9:50-10:30, 10/15/2026

Location 地點：Auditorium 大禮堂

Authors 作者：

Makoto Ochiai¹, Setsu Yamamoto¹

¹Corporate Laboratory, Toshiba

Abstract 摘要：

As countries accelerate their transition toward carbon neutrality, energy systems are undergoing profound transformation. The rapid expansion of renewable energy, the continuing role of nuclear power, and the growing complexity of energy infrastructure are redefining expectations for non-destructive testing (NDT). While safety and reliability remain fundamental responsibilities, NDT is increasingly expected to contribute to operational efficiency, asset availability, cost optimization, and the effective utilization of a limited workforce.

Renewable energy assets, including offshore wind farms and mega-scale solar power plants, are often located in remote and difficult-to-access environments. These conditions challenge the traditional assumption that inspections should be conducted primarily by skilled personnel on site. Moreover, several countries are already anticipating a substantial decline in

the availability of experienced inspection professionals. As a result, remote inspection technologies, robotic systems, and digital inspection ecosystems that integrate inspection, operation, and maintenance data are becoming increasingly important.

Nuclear power, which also plays an important role in decarbonization, faces similar pressures. Plant operators must maintain the highest standards of safety and inspection quality while reducing outage durations, labor requirements, and overall maintenance costs. Digitalization, advanced analytics, and optimized inspection strategies are therefore becoming essential for sustainable plant operation.

This presentation explores how the carbon-neutral energy transition is reshaping the mission of NDT. Drawing on examples from renewable energy and nuclear power applications, it highlights Toshiba's approaches to remote inspection, digital integration, and data-driven maintenance. It also discusses how inspection data can be utilized more effectively throughout the asset life cycle by connecting inspection activities with operation and maintenance. The presentation argues that the future role of NDT extends beyond safety assurance: NDT must evolve into a strategic enabler of sustainability, economic value creation, workforce resilience, and reliable energy infrastructure.

PS2: Plenary Speech 2, 大會演講 2

AI-HI (Human Intelligence) Integrated NDT and SHM

Speaker: Prof. Younho Cho

Session Chair: Prof. Yu-Hsi Huang

演講人: 趙允浩教授

主持人: 黃育熙教授

Time 時間 : 10:50-11:30, 10/15/2026

Location 地點 : Auditorium 大禮堂

Authors 作者 :

Younho Cho^{1*}, Igor Sakhabiev²

¹School of Mechanical Engineering, Pusan National University, Busan - 46241, Republic of Korea

²Graduate School of Mechanical Engineering, Pusan National University, Busan - 46241, Republic of Korea

*Corresponding Author: mechcyh@pusan.ac.kr

Abstract 摘要 :

The integration of Artificial Intelligence (AI) and Human Intelligence (HI) is redefining Structural Health Monitoring (SHM) and Non-Destructive Testing (NDT), evolving from manual inspections to collaborative defect localization. However, this synergy is threatened by industrial imperfections. Human operators may introduce annotation errors, acoustic coupling fluctuates, and training datasets are inherently imbalanced. If AI functions as a brittle "black box," engineers cannot trust its outputs during failures. The vital question remains: how resilient is the AI-HI partnership when underlying data, human inputs, or hardware degrade? This study investigates the fault-tolerance of a hybrid AI-driven ultrasonic tomography framework designed to ensure reliable decision-making support for human inspectors. A foundational aspect explores how human decisions during

model training, specifically, managing the class balance between healthy baseline paths and defectintersecting signals, directly dictate the spatial accuracy, artifact suppression, and visual clarity of the final tomographic images. To enhance real-world applicability, the model leverages bidirectional acoustic signal reciprocity, capturing physical hardware asymmetries to naturally augment the data. To simulate unpredictable industrial SHM environments, the framework is subjected to rigorous stress tests. First, we evaluate algorithmic resilience against human-centric and environmental data corruption by introducing controlled label noise, data downsampling, and feature perturbation. Next, physical operational hazards are simulated by selectively disabling piezoelectric sensors. Finally, a cumulative "dual stress test" combines heavily degraded AI models with simultaneous hardware failures to identify the system's ultimate breaking points. By shifting the focus from idealized performance to boundary-condition resilience, this research demonstrates how spatial self-correction mechanisms emerge under extreme stress. The findings prove that for successful AI-HI integration in SHM, the AI must operate as a transparent, mathematically grounded, and fault-tolerant partner capable of compensating for both data degradation and hardware limitations.

PS3: Plenary Speech 3, 大會演講 3

Evolution and Challenges of Automated Optical Inspection (AOI): From Precision 3D Metrology to AI-Powered Intelligent Inspection for Advanced Semiconductor Packaging

自動化光學檢測技術的發展與挑戰：從精密三維量測到 AI 驅動的智能半導體先進封裝檢測

Speaker: Prof. Liang-Chia Chen

Session Chair: Prof. Ju-Yi Lee

演講人: 陳亮嘉教授

主持人: 李朱育教授

Time 時間：11:30-12:10, 10/15/2026

Location 地點：Auditorium 大禮堂

Abstract 摘要：

Automated Optical Inspection (AOI) and precision optical metrology are essential non-destructive testing (NDT) technologies for process control and yield assurance in advanced manufacturing and semiconductor fabrication. This keynote reviews three decades of research by the speaker's team in opto-mechatronic integration, micro/nano-scale 3D metrology, and machine vision.

The research evolved from micro/nano-scale 3D optical metrology and dynamic MEMS characterization to full-field interferometry, confocal scanning, and high-speed, high-precision in-line inspection. With the rapid development of 3D ICs and sub-micron advanced packaging, conventional optical methods face fundamental diffraction-limited trade-offs among resolution, non-destructive measurement, and inspection speed.

To address these challenges, the team developed an intelligent in-line metrology approach integrating deep-ultraviolet (DUV) broadband digital wavefront sensing with AI-assisted electromagnetic inverse modeling. The technology enables non-destructive critical-dimension (CD) measurement of sub-micron openings and TSVs or blind vias with aspect ratios up to 15:1, while achieving up to a 28-fold improvement in signal-to-noise ratio (SNR). The presentation will also highlight technology commercialization through industry-academia collaboration and discuss future challenges and opportunities for AOI driven by the integration of AI and physics-based modeling.

自動化光學檢測（AOI）與精密光學量測是高階製造與半導體產業確保製程品質與良率的重要非破壞檢測（NDT）技術。本演講將回顧講者團隊三十年來在光機電整合、微奈米三維形貌量測及機器視覺領域的研究發展與關鍵突破。

研究由微奈米級三維光學量測與動態微機電系統（MEMS）形貌分析出發，逐步發展全場式顯微干涉與共軛焦掃描技術，並延伸至高速、高精度工業線上（In-line）檢測。面對 3D IC 與次微米先進封裝的快速發展，傳統光學方法受繞射極限限制，難以同時滿足高解析度、非破壞性與高速線上量測需求。

為突破此瓶頸，團隊進一步整合深紫外（DUV）寬頻數位波前感測、精密量測與 AI 深度學習之電磁反向推論，發展半導體先進封裝智能化線上光學檢測技術，可針對次微米開口及深寬比達 15:1 的矽穿孔（TSV）與盲孔進行非破壞性關鍵尺寸（CD）量測，並將量測信雜比（SNR）提升達 28 倍。本演講亦將介紹相關技術的產學合作與商品化成果，並探討 AI 與物理模型融合下，AOI 在先進製造與次世代 NDT 的發展方向與挑戰。

Keywords 關鍵字：

Automatic Optical Inspection (AOI) 自動化光學檢測, Non-Destructive Testing (NDT) 非破壞檢測, Advanced Packaging 先進封裝、Through-Silicon Via (TSV) 矽穿孔, Critical Dimension Metrology (CDM) 關鍵尺寸量測, Inverse Optimization in AI 人工智慧反向優化, Micro/Nano Precision Measurement 微奈米精密量測

PS4: Plenary Speech 4, 大會演講 4

AI in Quantitative Laser Ultrasound Visualization Technique

AI 浪潮中的定量雷射超音波可視化技術

Speaker: Prof. Che-Hua Yang

Session Chair: Prof. Ching-Chun Yin

演講人: 楊哲化教授

主持人: 尹慶中教授

Time 時間：10:10-10:50, 10/16/2026

Location 地點：Auditorium 大禮堂

Abstract 摘要：

非破壞檢測(Nondestructive testing, NDT)技術在確保結構物使用安全及工業製造品質控管中極具重要性，而其技術發展也因近年來人工智慧的迅速發展開啟了新的競逐。非破壞檢測中雷射超音波技術(Laser ultrasound technique)具備了非接觸檢測、高環境適應性以及高空間解析度等檢測上的先天優勢；而定量雷射超音波可視化 (Quantitative laser ultrasound visualization, QLUV) 技術更進一步借助高速高解析度空間掃描達到可視化的優勢而成為一個獨特的非破壞檢測技術。QLUV 是一個同時具備定性檢測及定量性質評估的全域性檢測量測技術：在定性上提供了待測物表面波傳動態可視化，並可藉以評估可能的缺陷特性；在定量評估上擷取了沿待測物波導傳播的時間-空間三維訊息，並藉由多點反算取得全域幾何及機械性質。無論是定性或是定量的應用，QLUV 均展現了有別於其他檢測技術的優越特性，然而人工智慧的成熟卻也提供了本技術發展一個嶄新的機會及方向：在定性檢測上，利用深度學習的缺陷評估將有機會取代傳統基於影像處理

或是單向濾波器的缺陷評估技術；而在定量評估上，基於深度學習的全新演算機制開發也將改進傳統耗時的逐點疊代反算法，增加即時性及實用性。

PS5: Plenary Speech 5, 大會演講 5

Metastructure for Nonlinear Ultrasonic Higher Harmonic Elimination

Speaker: Prof. Jaesun Lee

Session Chair: Prof. Ching-Chi Chen

演講人: 李宰先教授

主持人: 陳清祺教授

Time 時間 : 11:20-12:00, 10/16/2026

Location 地點 : Auditorium 大禮堂

Authors 作者 :

Boris I¹, Mohammed Aslam², Jonghwan Park³, Do-Kyung Pyun^{4,5},
Jaesun Lee^{4,5}

¹Research institute of DNA+, Changwon National University

²Interdisciplinary Research Center for Construction and Building
Materials, King Fahd University of Petroleum & Minerals, Dhahran, Saudi
Arabia

³Department of Smart Manufacturing Engineering, Changwon National
University, Changwon, South Korea

⁴School of Mechanical Engineering, Changwon National University,
Changwon, South Korea

⁵SMR2 Platform National Research Laboratory, Changwon National
University, Changwon, South Korea

Abstract 摘要 :

Ensuring the structural integrity of the structures through structural health monitoring (SHM) requires the early detection of minute imperfections such as microcracks at incipient stages. Nonlinear Lamb waves, which are characterised by the generation of higher-order harmonics, present a highly

sensitive method for identifying these micro-defects. However, effective signal analysis is challenged by extraneous nonlinear effects intrinsic to the system, which frequently mask genuine indicators of structural damage. To address this critical issue, advanced filtering techniques are essential for a reliable signal interpretation. This study introduces a novel metafilter comprising specifically engineered metallic rings to eliminate the unwanted harmonics induced by the system itself. The proposed metafilter utilises high-frequency stopbands to effectively attenuate undesired second harmonics without significantly compromising the wave-propagation distance. A comprehensive investigation into the frequency responses and mode shapes was conducted to reveal the wave dynamics when interacting with the metafilter. The performance of the filter was validated through rigorous three-dimensional time-step numerical simulations that accurately replicated wave-filter interactions. Experimental verification is provided by tests involving thin aluminium plates fitted with 3D-printed metafilters constructed from steel and aluminium materials, confirming the practical efficacy of the proposed design. Ultimately, this study highlights the critical role of metafilters in enhancing the reliability of nonlinear Lamb wave-based diagnostics. It offers a robust and practical solution for early damage detection, thereby significantly advancing the application of SHM methodologies in real-world scenarios.

EF1: Expert Form 1, 專家座談 1

Practical Applications of Offshore Wind Power Inspection

離岸風電檢測實務

Session Chair: Vice General Manager Pao-Hung Tong

Speakers: Ming-Hung Chang, Shun-Yuan Cheng

主持人: 非破壞高檢師、興達海基副總退休 董寶鴻副總

引言人:

中國鋼鐵股份有限公司 非破壞檢測課 張明弘工程師
金屬工業研究發展中心 鄭順元專案經理

Time 時間: 13:00-14:20, 10/15/2026

Location 地點: Auditorium 大禮堂

主題: 離岸風電管架接頭 UT 技術的國內發展及未來趨勢

引言人: 非破壞高檢師、興達海基副總退休 董寶鴻副總

主題: 離岸風電水下基礎鋼結構 NDT 檢測技術開發與應用

引言人: 中國鋼鐵股份有限公司 非破壞檢測課 張明弘工程師

主題: 風機葉片非破壞性檢測

引言人: 金屬工業研究發展中心 鄭順元專案經理

Abstract 摘要:

Non-destructive testing (NDT) plays a critical role in ensuring the quality and structural integrity of offshore wind turbine foundations and steel structures. Due to their complex geometry, tubular TYK joints in jacket structures present significant challenges in ultrasonic testing, defect

interpretation, and localization. The Metal Industries Research & Development Centre (MIRDC) has supported the development of Taiwan's offshore wind industry through NDT technology applications and workforce training. Through the Offshore Wind Power NDT Training Program, including basic and advanced courses, MIRDC has strengthened practitioners' capabilities in ultrasonic testing, inspection standards, acceptance criteria, and TYK joint defect evaluation. This session will share practical experience from NDT training and field applications, with a focus on workforce development and industry needs, aiming to enhance Taiwan's NDT capabilities and quality assurance for offshore wind structures.

非破壞檢測為離岸風電水下基礎及鋼結構品質確保的重要環節，其中 Jacket 管狀 TYK 接頭因幾何構造複雜，對超音波檢測、缺陷判讀及定位能力具有較高要求。金屬工業研究發展中心配合離岸風電產業發展，投入非破壞檢測技術應用及人才培育，並透過「離岸風電產業非破壞檢測人才培訓班」之基礎及進階課程，強化從業人員之超音波檢測實務、規範應用、允收標準及 TYK 接頭缺陷判定能力。本座談將分享相關培訓與檢測實務經驗，探討產業人才培育與檢測技術需求，期提升國內非破壞檢測量能及離岸風電結構品質。

EF2: Expert Forum 2, 專家座談 2

Semiconductor Inspection Technology

半導體檢測技術

Session Chair: Dr. Wei-En Fu

Speakers: Shih-Hsin Chang, Shao-Yu Chang, Jen-Chieh Wang, Chia-Che Hsieh, Gaurav Pandey

主持人: 傅尉恩博士

Time 時間 : 14:40-16:00, 10/15/2026

Location 地點 : Auditorium 大禮堂

Time 時間	Topic 主題	Speaker 演講人
14:40	The role of non-destructive analysis in semiconductor fault analysis	Shih-Hsin Chang
14:55	Snapshot hyperspectral metrology: 4,000 spectrometers working in parallel	Shao-Yu Chang
15:10	Measurement Solutions for 3D IC Vertical Vias	Jen-Chieh Wang
15:25	AFM application from mm to pm in AI Era– Hybrid bonding challenges and metrology	Chia-Che Hsieh
15:40	X-ray Metrology for Advanced Semiconductor Logic Devices	Gaurav Pandey

Topic: The role of non-destructive analysis in semiconductor fault analysis

Speaker: Shih-Hsin Chang, Director

Bio: Dr. Chang currently serves as the Director of the Technical Marketing and Professional Development Division at MSS. He received his bachelor's degree in Physics from National Sun Yat-sen University and Ph.D. in

Materials Science and Engineering from National Tsing Hua University. With a strong foundation in fundamental science and hands-on failure analysis, he has a proven ability to translate deep technical expertise into global marketing strategies that drive brand growth and market penetration.

Topic: Snapshot hyperspectral metrology: 4,000 spectrometers working in parallel

Speaker: Shao-Yu Chang, Senior Optical Engineer

Bio: Dr. Chang is a Senior Optical Engineer at Living Optics, specializing in optical system design and hyperspectral imaging. He has over seven years of experience in optics, with expertise in imaging cameras, diffractive optical systems, and hyperspectral imaging. His current work focuses on snapshot hyperspectral cameras for real-time spectral imaging and metrology applications.

Topic: Measurement Solutions for 3D IC Vertical Vias

Speaker: Jen-Chieh Wang, CSO

Bio: Dr. Jen-Chieh Wang currently serves as Chief Strategy Officer at OmniMeasure Technology Inc., a precision metrology innovator for semiconductor manufacturing and a spin-off startup from Industrial Technology Research Institute (ITRI). With a background in physics and engineering, Dr. Wang holds a Ph.D. in Mechanical and Aerospace Engineering from Nanyang Technological University, a master's degree in Physics from State University of New York at Buffalo, and a bachelor's degree in Physics from National Taiwan University. Prior to joining OmniMeasure, Dr. Wang held various roles at Center for Measurement Standards / Industrial Technology Research Institute (CMS/ITRI), including Deputy Director of Green Energy Testing and Certification Division, Deputy Business Development Director of Planning and Promotion Division, Manager of Industrial Strategy Execution Department, and the international business of National Measurement Laboratory. His international and industrial involvement includes serving as Taiwan's representative of SEMI International Standards Committee (ISC), invited expert of ISO TC299, Secretary-General of Automatic Optical Inspection Equipment Association (AOIEA), Secretariat of SEMI Taiwan Inspection & Metrology Committee, Secretariat of CIE-Taiwan, and a member of National Standards Technical Committee. He also has the experience in regulatory review for medical device pre-market evaluation and applies

quality management system to help translating innovative technologies from the pioneering startup into commercial products for the semiconductor industry.

Topic: AFM application from mm to pm in AI Era– Hybrid bonding challenges and metrology

Speaker: ChiaChe Hsieh, Technical Manager

Bio: 20 years Metrology and AFM Application experience from offline research to inline production, Focus on adopting new AFM solution to production line.

Topic: X-ray Metrology for Advanced Semiconductor Logic Devices

Speaker: Gaurav Pandey

Bio: Ph.D. researcher at National Taipei University of Technology (NTUT), working in collaboration with ITRI on advanced X-ray metrology for semiconductor nanostructures. His research focuses on reflection-mode X-ray scattering and model-based inverse analysis for dimensional characterization of next-generation semiconductor structures.

EF3: Expert Forum 3, 專家座談 3

CNS Maintenance and Non-Destructive Testing Personnel Qualification Verification Implementation

CNS 維護及非破壞檢測人員資格驗證執行

Session Chair: General Manager Yung-Shun Su
The Society for Nondestructive Testing & Certification of Taiwan General
Manager/NDT Level III

Speaker: P.K. Chen
Member of CNS Technical Committee/Member of Association
Certification Standards Convener/Nondestructive Testing Level 3

Speaker: Kent Cheng
The Society for Nondestructive Testing & Certification of Taiwan Chief
Secretary

主持人: 協會總經理/高檢師 蘇詠舜

引言人:
國家標準技術委員/協會授證標準規範委員會召集人/高檢師 陳必貫
協會主任秘書 鄭靖洲

Time 時間 : 16:00-17:20, 10/15/2026

Location 地點 : Auditorium 大禮堂

Topic 演講主題 : Maintenance of National Standards (CNS) of the Republic of China (Non-destructive Testing) 非破壞領域國家標準維護

Speaker 引言人 : Member of CNS Technical Committee/Member of Association Certification Standards Convener/Nondestructive Testing Level 3, P.K. Chen 國家標準技術委員 / 協會授證標準規範委會召集人 陳必貫高檢師

Abstract 摘要 :

1. Statistics 統計

Item 項次	Project 項目	Classification 分類	Total number of CNS 總數	Number of CNS 提案數
001	Existing CNS 既有現行	Revising 修訂	58	27
		Revoke 廢止		2
002	ISO	Formulating 制定	30	17
003	Total 小計		88	46

2. The CNS revisions approved for processing this year (2016) 今(115)年核定國家標準修訂草案建議

3. Follow-up planning 後續規劃

3.1.Principium 原則：BSMI project approval and contract 標檢局計畫核定及合約委託

3.2.BSMI project approval and contract 近期：5 pieces per year 每年 5 件

Topic 演講主題：Current Status of ISO 9712 Nondestructive Testing Personnel Qualification Certification ISO 9712 非破壞檢測人員資格驗證

Speaker 引言人：The Society for Nondestructive Testing & Certification of Taiwan Chief Secretary, Kent Cheng 協會主任秘書 鄭靖洲

Abstract 摘要：

1. MRA/MLA Requirements 國際互認要求

2. Standards and Current Implementation 規範與現階段執行

2.1.Certification(Training/Qualification/Granting/Renewal/Recertification) 驗證
(訓練 / 資格檢定 / 授證 / 換證 / 重新驗證)

2.2.Number of certificates 證書數量

Level 等級	Number of certificate holders 持證人數	Number of certificates 證書張數		
		Welds 銲件	Manufacturing 金屬製程	Pre- and- in-service testing 運轉前和營運期間
I	587	246	99	369
II	1430	560	385	2293
III	87	13	8	270

2.3.Non-destructive activity approval 非破壞活動認列

2.4.Complaint/Appeals 抱怨/申訴

3. Frequently Asked Questions 常見問題

4. Forecast 展望

EF4: Expert Forum 4, 專家座談 4

Development and Application of Nondestructive Testing (NDT) Technologies in Power Plant Decommissioning and Re-operation

非破壞檢測技術在電廠除役及再運轉之發展與應用

Session Chair: Dr. Kuang-Chih Pei

Speakers: Jen-Hung Chen, D.W. Lin, Hung-Fa Shyu,
Ilham Mukriz Zainal Abidin, Yaw-Hwa Shiu

主持人: 裴廣智博士

引言人: 陳仁宏, 林東威, 徐鴻發, Ilham Mukriz Zainal Abidin, 胥耀華

Time 時間 : 13:00-14:20, 10/16/2026

Location 地點 : Auditorium 大禮堂

Abstract 摘要 :

Taiwan's energy policy has undergone a major shift since 2026, officially listing "nuclear power restart" as a possible option. Objectively speaking, the three main driving forces behind this policy shift can be attributed to: the explosive growth in electricity consumption in the AI era, geopolitical and energy security concerns, and international pressure for carbon reduction and green supply chains. This expert panel discussion will offer insights and discussions on the development and application of non-destructive testing (NDT) technologies in power plant decommissioning and reactivation. The discussion will cover NDT technological advancements in domestic industry and academia, such as power plant component aging management solutions, hot chamber inspection experience, and the specific requirements of the nuclear power sector. The discussion also hopes to provide insights and perspectives from invited overseas expert on the NDT technologies needed for nuclear power and nuclear safety in response to

electricity demand. The experts invited have extensive experience in the nuclear energy field, both in practical application and academic research, spanning two to three decades. Their expertise should bring new value and inspiration to the participants.

台灣的能源政策自 2026 年起出現重大轉向，正式將「核電重啟」列為可能選項。而政策轉向的三大推動力，客觀而言可歸因於：AI 時代用電量暴增、地緣政治與能源安全、還有國際減碳與綠色供應鏈壓力。本場專家座談中，將對非破壞檢測技術在電廠除役及再運轉方面之發展與應用，提出見解及討論。座談內容將涉及國內產學界的技術進展，如電廠組件老化管理方案、熱室檢驗經驗及核電領域的特殊要求等。座談中也希望能透過邀請的海外專家，觀察到因應電力需求，對核電及其核安所需的非破壞檢測技術，有所企求與展望。本次座談邀請的專家，多在核能領域，現場實務及學術研究上，深耕二、三十年，其經驗學識應能帶給現場新的價值對話與啟發。

EF5: Expert Forum 5, 專家座談 5

Development of NDT Applications for Steel Structures

鋼結構 NDT 應用發展

Session Chair / Speaker: Dr. Peng-Chi Peng

主持人/引言人: 彭朋畿博士

引言人: 吳峻傑, 姬俊宇, 余金賢, 劉松明

Time 時間 : 14:40-16:00, 10/16/2026

Location 地點 : Auditorium 大禮堂

Abstract 摘要 :

In recent years, steel structures have been widely adopted by the engineering and construction industries in Taiwan due to their excellent seismic performance. They are extensively used in a variety of applications, including buildings, industrial plants, bridges, and wind turbine structures. For steel structures, nondestructive testing (NDT) is primarily applied to the inspection of steel plates, welds, and bolts. Commonly used NDT methods include visual testing (VT), radiographic testing (RT), ultrasonic testing (UT), magnetic particle testing (MT), and penetrant testing (PT). This forum will review recent technical developments in these methods and introduce the application of unmanned aerial vehicles (UAVs) in NDT, with the aim of providing the engineering community with useful technical information for reference and evaluation.

近年由於鋼結構之耐震效果佳，故已廣為國內工程業界所接受，包括建築、廠房、橋樑與風機，並大量生產與製造。針對鋼結構建築，目前非破壞檢測主要應用於鋼板、銲道與螺栓，其中較常見之非破壞檢測方法，包括目視檢測法(VT)、放射線檢測法(RT)、超音波檢測法(UT)、磁粒檢測法(MT)、液滲檢測法(PT)。本論壇將介紹上述方法近

期技術發展現況，同時介紹無人機之非破壞檢測(NDT)應用，以提供工程業界參考與評估。

SS4: Advanced Electromagnetic Testing Invited Talks, 先進電磁測試專家演講

Session Chair: Yu-Ching Lee

主持人: 李雨青

Time 時間: 13:00–13:27, 10/16/2026

Location 地點: Lo Chia-Lun Lecture Hall 羅家倫講堂

Paper ID 論文編號: 1091 (Invited Talk)

Wave Characteristics of Magneto-Electro-Elastic Laminates with Imperfect Interfaces

Yun-Hsuan Wang¹, Kuang-Hung Wei¹, Hsin-Yi Kuo^{1*}

¹Department of Civil Engineering, National Yang Ming Chiao Tung University

*Corresponding Author: hykuo@nycu.edu.tw

We investigate the wave characteristics of the magneto-electro-elastic (MEE) laminated plates with interface imperfections. The MEE multilayer is assumed as a simply supported rectangular plate subjected to the appropriate boundary conditions. Both the generalized linear spring-type and generalized membrane-type imperfect interfaces are considered. We employ the pseudo-Stroh formalism and the propagator matrix method to establish the analytical solutions for an orthotropic MEE laminate. The derived solutions are then applied to BaTiO₃-CoFe₂O₄ sandwich plates. Numerical calculations show that the interface imperfection would be possible to tune wave features for the given layup.

Time 時間: 13:27–13:54, 10/16/2026

Location 地點: Lo Chia-Lun Lecture Hall 羅家倫講堂

Paper ID 論文編號: 1110 (Invited Talk)

Stress Position Detection Using Magnetoelastic Stray Magnetic Fields for Early Diagnosis of Industrial Structures

Gye Jo Jung^{1*}

¹SPDTech

*Corresponding Author: keprica63@naver.com

Large industrial assets contain extensive welds and highly loaded ferromagnetic regions, making full-area examination by detailed nondestructive testing (NDT) time- and resource-intensive. Stress Position Detection (SPD) is a passive magnetic pre-screening approach implemented within the Metal Magnetic Memory (MMM) framework. It measures spatial variations in the magnetic stray field without intentional magnetization and localizes abnormal regions, termed Stress Positions, for subsequent examination. This paper describes the measurement concept and summarizes field evidence from power-generation components and a welded tubular transmission tower. The accumulated power-generation work comprised 14,920 measurement points and a reported inspection length of 21,871,733 mm across four generating units. Five representative SPD-selected locations were subsequently examined by phased-array ultrasonic testing (PAUT), ultrasonic testing (UT), post-cut examination, or replica metallography. The follow-up results included an internal slag inclusion in a header stub-tube weld, lack of fusion in a high-pressure pipe weld, incomplete penetration in a tubular transmission-tower weld, internal fatigue-related micro-cracking in a low-temperature reheater weld, and sulfide corrosion on a boiler water-wall tube. These cases demonstrate a consistent localization and prioritization function across different degradation conditions and verification methods. They do not establish standalone defect classification, sizing accuracy, or probability of detection. SPD is therefore positioned as a screening layer that directs conventional NDT to priority locations and supports condition-based inspection planning. Further prospective studies with predefined acceptance criteria and representative samples are required to quantify performance for each application.

EC: English Competition, 英文論文競賽

Judges: Chih-Hung Chiang, Ching-Chung Yin, Ching-Chi Chen

評審: 江支弘, 尹慶中, 陳清祺

Time 時間 : 13:00-14:48, 10/15/2026

Location 地點 : Future Classroom 未來教室

Time 時間	Paper ID 論文編號	Title 演講題目	Authors 作者
13:00-13:18	1023	Design of a Yoke-Type Eddy Current Sensor for Crack Detection in Metals	Yu-An Chen, Chun-Yeon Lin
13:18-13:36	1045	Aerospace Turbine Blade Defect Detection Using Machine Vision and Balanced Feature Fusion	Yi-Kai Chao, Jing-Feng Weng
13:36-13:54	1056	Feasibility of Point Cloud Reconstruction for Wind Turbine Blades from Unplanned Drone Video: A COLMAP Parameter Sensitivity Study	Mahesh, Liu-Chao Hsien, Wei-Long Chen, Yung-Chiang Lin, David Kumar, Sneha Prasad, Chih-Hung Chiang
13:54-14:12	1065	Low-Cost Acoustic Non-Destructive Evaluation using 3D-Printed Stethoscope Probe	Aufa Ulin Nuha, Yin Jui Tseng, Jung Ting Tsai
14:12-14:30	1083	Anomaly Detection of Tipping Bucket Rain Gauges Using a Machine Learning Model with Multi-Domain Vibration Signal Features	Ting-Yu Chien, Chin-Ho Liu, Shang-Chih Lin, Shun-Feng Su, Yennun Huang
14:30-14:48	1104	Optimizing Lock-in Thermography for Reliable Defect Detection in Thermal Barrier Coatings	Jiwon Park, Jonghwan Park, Yeongil Choi, Hunhee Kim, Do-Kyung Pyun, Jaesun Lee

Time 時間: 13:00–13:18, 10/15/2026

Location 地點: Future Classroom 未來教室

Paper ID 論文編號: 1023

Design of a Yoke-Type Eddy Current Sensor for Crack Detection in Metals

Yu-An Chen¹, Chun-Yeon Lin^{1*}

¹Department of Mechanical Engineering, National Taiwan University

*Corresponding Author: chunyeonlin@ntu.edu.tw

Eddy current testing is widely used for crack detection in electrically conductive structures. However, the quantitative evaluation of back-surface cracks remains challenging because the eddy current density decreases with depth owing to the skin effect. This study proposes a simultaneous multi-frequency eddy current sensing method for the single-sided detection and depth estimation of back-surface cracks in nonferromagnetic metal plates. The proposed probe integrates two printed circuit board (PCB) excitation coils, a magnetic yoke, and a tunnel magnetoresistance sensor. Synchronous demodulation is employed to extract the sensor response at each excitation frequency. A three-dimensional finite element model was developed to investigate the frequency-dependent redistribution of eddy currents in the vicinity of back-surface cracks. The normalized crack response exhibited a polarity reversal from negative to positive as the excitation frequency increased. Accordingly, the zero-crossing frequency was defined as the transition frequency and used as an indicator of crack burial depth. The simulation results showed that the transition frequency decreased from approximately 515 to 306 Hz as the burial depth increased from 2 to 5 mm. Experiments conducted on a 6061 aluminum alloy plate successfully detected and localized four back-surface cracks. For actual burial depths of 2, 3, 4, and 5 mm, the corresponding estimated depths were 1.57, 2.61, 2.78, and 4.09 mm, respectively. These results demonstrate the feasibility of transition-frequency-based detection and depth estimation of back-surface cracks in nonferromagnetic metal structures under single-sided inspection conditions.

Time 時間: 13:18–13:36, 10/15/2026

Location 地點: Future Classroom 未來教室

Paper ID 論文編號: 1045

Aerospace Turbine Blade Defect Detection Using Machine Vision and Balanced Feature Fusion

Yi-Kai Chao¹, Jing-Feng Weng^{1*}

¹Department of Mechanical and Energy Engineering, National Chiayi University

*Corresponding Author: jfweng@mail.ncyu.edu.tw

Aerospace turbine blades are susceptible to surface and edge defects such as Crack, Scratch, and Nick, while reflections, local luminance gradients, and surface texture on metallic blades can reduce defect visibility. This study proposes a luminance-preserving hierarchical three-channel Balanced Feature Fusion (BFF) method for turbine-blade defect detection. The multi-exposure fused image is retained as a luminance anchor, from which a high-frequency Detail representation and a composite Defect representation constructed from Top-hat, Black-hat, and Laplacian responses are hierarchically generated and introduced into separate input channels. BFF (Selected) uses direct Detail and Defect injection weights of 16% each while preserving the original image dimensions and annotation coordinates for YOLOv4. For identical representative defect cases, the confidence scores of Crack and Nick increased from 0.87 and 0.73 for HDR (Baseline) to 0.93 and 0.88 for BFF (Selected), respectively, while Scratch remained at 0.92. This comparatively balanced response across the three representative defect morphologies motivated the use of D16/R16 as the principal BFF configuration. On the full 78-image dataset containing 203 annotated defects, BFF (Selected) achieved AP@0.5 values of 79.19%, 87.68%, and 82.56% for Crack, Scratch, and Nick, respectively, yielding an overall mAP@0.5 of 83.14%. Increasing the confidence threshold from 0.25 to the final operating point of 0.60 increased Precision from 0.65 to 0.82 while Recall decreased from 0.89 to 0.72. BFF input generation required approximately 0.18 s per 600×800 image on the tested Intel Xeon CPU. Full-dataset sensitivity analysis further showed that detector behavior depends strongly on direct feature-injection strategy, indicating that effective multi-class inspection depends on both balanced input-feature organization and appropriate operating-point selection.

Time 時間: 13:36–13:54, 10/15/2026

Location 地點: Future Classroom 未來教室

Paper ID 論文編號: 1056

Feasibility of Point Cloud Reconstruction for Wind Turbine Blades from Unplanned Drone Video: A COLMAP Parameter Sensitivity Study

Mahesh^{1*}, Liu-Chao Hsien¹, Wei-Long Chen^{1,2}, Yung-Chiang Lin³,
David Kumar⁴, Sneha Prasad⁴, Chih-Hung Chiang^{1,3}

¹Graduate Institute of Aeronautics, Chaoyang University of Technology

²Department of Industrial Design, Chaoyang University of Technology

³Department of Civil and Construction Engineering, Chaoyang University of
Technology

⁴Department of Aerospace Engineering, Indian Institute of Technology Madras

*Corresponding Author: t2024016@gm.cyut.edu.tw

Wind turbine blade inspection relies increasingly on unmanned aerial vehicles, yet the images collected support damage detection rather than geometric assessment. This paper tests the feasibility of recovering blade geometry from unplanned inspection footage using structure from motion. Video was recorded at a coastal wind farm in Taiwan, using a parked utility-scale turbine. The drone was flown manually with no flight plan, no calibration and no ground control. A contiguous block of 26 frames from one continuous pass was partially reconstructed in COLMAP under fourteen configurations, covering eight camera models, three feature detectors and two matchers. Every configuration registered all 26 frames. Point density varied by only about 5% across seven of the eight camera models, while the FOV model returned 16% more points at three times the runtime. Sharing intrinsic parameters across frames gained a further 7% over per-image parameters. SIFT with LightGlue achieved the lower mean reprojection error at 1.013 pixels, and both SIFT configurations returned over four times the point cloud density of ALIKED and LoMa at default settings. Reconstruction took between 1.4 and 4.1 minutes on a single workstation GPU. Unplanned inspection footage can therefore be reconstructed without expert parameter tuning or additional sensing.

Time 時間: 13:54–14:12, 10/15/2026

Location 地點: Future Classroom 未來教室

Paper ID 論文編號: 1065

Low-Cost Acoustic Non-Destructive Evaluation Using 3D-Printed Stethoscope Probe

Aufa Ulin Nuha¹, Yin-Jui Tseng¹, Jung-Ting Tsai^{1*}

¹Department of Mechanical Engineering, National Taiwan University of Science and Technology

*Corresponding Author: tsaij@mail.ntust.edu.tw

Real-time condition assessment of machinery can support early detection of abnormal operating states while reducing dependence on costly and complex monitoring infrastructure. This study presents a low-cost acoustic non-destructive evaluation system that combines a Digital Light Processing (DLP) resin-printed contact-stethoscope dome probe with a browser-based signal-processing platform. The passive probe is placed against an accessible machine surface and is designed to enhance structure-borne acoustic signals through a resonant air cavity without requiring electronic components at the sensing element. Acoustic data are acquired and processed within a web browser using the Web Audio API. The processing pipeline includes DC-offset removal, Hann windowing, a 4096-point Fast Fourier Transform at a sampling frequency of 400 Hz, Harmonic Product Spectrum (HPS) analysis, and a three-stage adaptive filtering scheme. Particle Swarm Optimization (PSO) is used to calibrate the filter parameters while machine-specific frequency baselines are stored and updated through a Google Sheets-based cloud mechanism. Experimental validation was conducted on a household fan under four operating states (off, speed 1, speed 2, and speed 3). Across ten trials per state, the system achieved classification accuracies of at least 90% for speed 1 and speed 2, with a frequency-bin spacing of approximately 0.0977 Hz and an end-to-end latency below 200 ms. Performance decreased to below 50% for speed 3 because airflow-induced broadband noise obscured the motor-related harmonic signature. The results demonstrate the feasibility of a portable, installation-free acoustic monitoring architecture, while also identifying the need for improved wind protection, contact coupling, and multi-feature classification under strong airflow interference.

Time 時間: 14:12–14:30, 10/15/2026

Location 地點: Future Classroom 未來教室

Paper ID 論文編號: 1083

Anomaly Detection of Tipping Bucket Rain Gauges Using a Machine Learning Model with Multi-Domain Vibration Signal Features

Ting-Yu Chien¹, Chin-Ho Liu², Shang-Chih Lin^{3*}, Shun-Feng Su⁴,
Yennun Huang⁵

¹Graduate Institute of Intelligent Manufacturing Technology, National Taiwan University of Science and Technology

²In-service degree program of Master of Information and Electrical Engineering, Feng Chia University

³Department of Automatic Control Engineering, Feng Chia University

⁴Department of Electrical Engineering, National Taiwan University of Science and Technology

⁵Research Center for Information Technology Innovation, Academia Sinica

*Corresponding Author: sclin@fcu.edu.tw

Changes in precipitation patterns have increased the need for reliable rainfall monitoring. Tipping-bucket rain gauges are widely used for precipitation measurement; however, their measurement reliability can be affected by mechanical abnormalities during operation. This study proposes a machine learning-based approach for detecting abnormal TBRG operating conditions using vibration signal characteristics. Non-destructive vibration measurements are acquired during TBRG operation, and features are extracted from the time, frequency, and time-frequency domains. The extracted features are evaluated, ranked, and selected based on their diagnostic relevance to construct the machine learning dataset. Experimental results demonstrate that the proposed approach achieves stable and reliable classification performance under the investigated operating conditions, with an accuracy of 100 %. The results confirm the feasibility of vibration-based condition monitoring for identifying abnormal TBRG operation and providing an additional diagnostic capability for improving the reliability of precipitation measurements. Future work will focus on reducing hardware complexity and system footprint to facilitate practical deployment and enhance the commercial potential of the proposed approach.

Time 時間: 14:30–14:48, 10/15/2026

Location 地點: Future Classroom 未來教室

Paper ID 論文編號: 1104

Optimizing Lock-in Thermography for Reliable Defect Detection in Thermal Barrier Coatings

Jiwon Park¹, Jonghwan Park¹, Yeongil Choi¹, Hunhee Kim²,
Do-Kyung Pyun^{3*}, Jaesun Lee^{3*}

¹Department of Mechanical Engineering, Changwon National University

²Doosan Enerbility

³School of Mechanical Engineering, Changwon National University

*Corresponding Authors: dpyun@changwon.ac.kr, jaesun@changwon.ac.kr

Lock-in thermography was investigated for the detection of subsurface defects in thermal barrier coatings (TBCs). Experiments were conducted on TBC specimens containing artificial interfacial defects while varying the excitation frequency, number of heating cycles, and excitation waveform. Amplitude and phase images were obtained from the thermal responses, and defect detectability was quantitatively evaluated using the signal-to-noise ratio (SNR), contrast-to-noise ratio (CNR), and MTF50. The results were compared to identify excitation conditions that provide reliable defect contrast and spatial resolution. This study provides a basis for optimizing lock-in thermography conditions for nondestructive inspection of TBC structures.

CC: Chinese Competition, 中文論文競賽

Judges: Chih-Hung Chiang, Ching-Chung Yin, Ching-Chi Chen

評審: 江支弘, 尹慶中, 陳清祺

Time 時間: 15:12-17:00, 10/15/2026

Location 地點: Future Classroom 未來教室

Time 時間	Paper ID 論文編號	Title 演講題目	Authors 作者
15:12-15:30	1037	應用於手腕橈動脈脈搏波量測之壓電感測器結構設計與訊號特性分析	林凱芸, 黃育熙
15:30-15:48	1038	車用齒輪箱變速工況振動訊號特徵擷取與故障診斷	張瑋翔, 黃鈺晶, 吳育仁
15:48-16:06	1052	雙相多疊層結構黏結品質非破壞檢測技術開發	陳建穎, 楊哲化, 王睿謙
16:06-16:24	1055	基於 Field II 可控次諧波散射體模擬之超音波定量特徵穩健性評估與排序	林皇辰
16:24-16:42	1087	廣義疊加分段理論分析複雜幾何連接板之面內動態行為與驗證	許建核, 李維哲, 吳亦莊
16:42-17:00	1100	基於分佈式光纖聲學感測 (Distributed Acoustic Sensing, DAS) 系統之船錨事件聲紋量測方法	顏汝珊, 林庭寬, 洪裕涵

Time 時間: 15:12-15:30, 10/15/2026

Location 地點: Future Classroom 未來教室

Paper ID 論文編號: 1037

應用於手腕橈動脈脈搏波量測之壓電感測器結構設計與訊號特性分析

林凱芸^{1*}, 黃育熙²

¹ 國立臺灣大學奈米工程與科學學位學程

² 國立臺灣大學機械工程學系

*Corresponding Author: kai.y17xx@gmail.com

本研究主要針對手腕橈動脈脈搏波量測之壓電感測器進行結構設計與訊號特性分析，建立可重複週期下壓之測試平台，以平均峰值與平均響應時間差評估不同感測結構。圓形壓電感測器結果顯示，環形支撐與較柔軟探頭可提升時間響應一致性，不同探頭之接觸尺寸與幾何形狀亦會影響重複載入下之輸出峰值與長時間穩定性。矩形壓電感測器則透過元件尺寸與探頭接觸面之設計提升輸出表現，並以組合式懸臂梁探頭完成實際手腕脈搏訊號量測。理論分析與 COMSOL 有限元素模擬進一步顯示，壓電陶瓷長度、厚度與半徑皆會影響輸出，且適度減少材料用量仍可維持或提升訊號。研究結果可作為手腕式壓電脈搏感測器之結構與材料配置設計參考。

Time 時間: 15:30-15:48, 10/15/2026

Location 地點: Future Classroom 未來教室

Paper ID 論文編號: 1038

車用齒輪箱變速工況振動訊號特徵擷取與故障診斷

張瑋翔¹, 黃鈺晶¹, 吳育仁^{1*}

¹ 國立中央大學機械系

*Corresponding Author: yurenwu@ncu.edu.tw

本研究針對電動車用二級減速齒輪箱於變轉速工況下之振動故障診斷，建立結合角度重採樣、階次分析與包絡分析之特徵擷取流程。於輸入軸、中間軸及輸出軸旁設置三組三軸加速規，量測升速、穩速及減速過程之振動訊號，並以 30 筆健康齒輪箱資料建立統計基準。結果顯示，RMS 與峰值因數受量測方向影響，故障特徵未呈一致增加；第一與第二齒輪嚙合階次振幅超過健康門檻之比例僅為 22.2%與 0%。相較之下，輸入軸、中間軸及輸出軸故障之包絡軸轉階次振幅超過門檻比例分別為 86.7%、100% 及 100%。結果證實，包絡階次分析能較

穩定提取齒輪撞傷所造成之軸轉週期調變特徵，可作為變轉速齒輪箱異常篩檢與故障軸位置辨識之依據。

Time 時間: 15:48–16:06, 10/15/2026

Location 地點: Future Classroom 未來教室

Paper ID 論文編號: 1052

雙相多疊層結構黏結品質非破壞檢測技術開發

陳建穎^{1*}, 楊哲化¹, 王睿謙¹

¹國立臺北科技大學製造科技研究所

*Corresponding Author: chencoc0105@gmail.com

雙相多疊層結構由約 280 層、厚 70 mm 自黏電磁矽鋼片組成，界面造成散射與衰減。本研究以高能量超音波穿透檢測（HEUT）、超音波衰減頻譜（UAS）與定量雷射超音波可視化（QLUV）評估三類樣品各兩件。180 kHz HEUT 工程等效波速指標可分群，良品 4575.3–5025.1 m/s、尚可品 4066.8–4186.5 m/s；穿透率指標僅宜作為輔助。UAS 良品主峰 180–190 kHz 且 CV<5%，尚可品 CV>13%， Δf 約 48.8 kHz 不具鑑別性。QLUV 以 180 kHz 揭示齒部波傳差異，並以 1 MHz 定位外圓脫層。三種方法分別提供整體等效剛性相關資訊、界面均勻性與缺陷空間分布，形成互補檢測架構。

Time 時間: 16:06–16:24, 10/15/2026

Location 地點: Future Classroom 未來教室

Paper ID 論文編號: 1055

基於 Field II 可控次諧波散射體模擬之超音波 定量特徵穩健性評估與排序

林皇辰^{1*}

¹ 國立屏東科技大學資訊管理系

*Corresponding Author: linhuangchen@mail.npust.edu.tw

非線性次諧波超音波檢測在閉合裂縫、接觸界面與微觀材料劣化表徵中具備極高靈敏度，然而傳統時序振幅分析易受儀器增益、聲衰減與背景雜波干擾，且真實材料缺陷往往缺乏絕對真實基準（Ground Truth），限制了定量特徵之客觀篩選。本研究於 Field II 線性陣列換能器平台建立可重現之次諧波檢測模擬架構，提出雙激發態可控非線性散射體假體模型，在基質中導入可控次諧波強度分量（ $\alpha = 0.0 \sim 1.0$ ），構建具絕對真值的虛擬校準標的。在統一因子條件下（散射體濃度 4-32 個/mm²），平行萃取並比較灰階共生矩陣（GLCM）、視窗調變複合 Nakagami 參數比值（ Mcr ）、局部二值模式（LBP）與累積殘差熵（CRE）。結果顯示 Nakagami 比值（ $\rho = 0.973$ ）與 CRE（ $\rho = 0.809$ ）展現高度跨濃度單調一致性，能有效抑制線性基質雜波；反之 GLCM 對比度則出現濃度相依之非單調反轉。本方法為 NDE 4.0 模擬驅動數位孿生資料前置層提供可靠之量化特徵選取依據。

Time 時間: 16:24-16:42, 10/15/2026

Location 地點: Future Classroom 未來教室

Paper ID 論文編號: 1087

廣義疊加分段理論分析複雜幾何連接板之面內動態行為與驗證

許建核¹, 李維哲², 吳亦莊^{1*}

¹ 國立台灣科技大學機械工程學系

² 國立中正大學機械工程學系

*Corresponding Author: ycwu@mail.ntust.edu.tw

本文採用廣義疊加分段理論探討等向性薄矩形板及其連接板結構於任意邊界條件下面內振動之動態特性，並透過有限元素分析與電子斑點干涉術進行數值及實驗驗證。首先，依據平面應力狀態建立薄板面內振動控制方程，結合 Gorman 理論、Lévy 型解法及正交展開建立特徵

矩陣，以處理不同邊界條件；進一步於連接邊施加位移連續與膜力平衡條件，將理論延伸至複雜連接板。數值分析採用 Abaqus 比較自然頻率與模態振型，結果與理論預測具有良好一致性。實驗則利用壓電致動器激振，並以電子斑點干涉術量測面內振動模態，其共振頻率與理論結果之平均誤差為 0.69%，最大誤差為 1.87%。結果顯示，本方法可準確預測單板及連接板之面內振動特性，並具應用於複雜連接結構分析之延伸性。

Time 時間: 16:42-17:00, 10/15/2026

Location 地點: Future Classroom 未來教室

Paper ID 論文編號: 1100

基於分佈式光纖聲學感測（Distributed Acoustic Sensing, DAS）系統之船錨事件聲紋量測方法

顏汝珊^{1*}, 林庭寬¹, 洪裕涵¹

¹ 國立中山大學光電工程系

*Corresponding Author: ameliayuyuan@gmail.com

海底通訊光纜為全球資訊傳輸之重要基礎設施，船錨拖曳與撞擊所造成之外力破壞，可能影響海纜安全運作。為提升海纜主動防護能力，本研究建立基於分佈式光纖聲學感測（Distributed Acoustic Sensing, DAS）系統之船錨事件聲紋量測方法，於砂質介質模擬海床環境中，量測環境背景雜訊、船錨敲擊、拖曳及敲擊伴隨拖曳等事件。實驗結果顯示，不同船錨事件具有明顯之時域與時頻特徵，且 40 cm 與 80 cm 量測距離下皆可辨識其基本特徵；隨量測距離增加，訊號頻譜能量受到傳播衰減影響而產生變化。結果驗證 DAS 系統量測船錨事件聲紋之可行性，可作為後續船錨事件辨識與海纜早期預警之基礎。

CP: Chinese Poster Session, 中文海報競賽

Session Chairs: Ping-Sheng Huang, Jin-Jhy Jeng

主持人: 黃炳森, 鄭錦智

Time 時間: 13:00-14:35, 10/15/2026

Location 地點: Multi-Functional Classroom 多功能教室

Time 時間	Paper ID 論文編號	Title 演講題目	Authors 作者	Competition 競賽
13:00-13:05	1003	電弧效應的生成與對材料組織的影響	陳奕成, 鄭銘文	★
13:05-13:10	1013	傳統超音波檢測與相位陣列超音波檢測技術比較及其於焊道缺陷檢測之應用	陳偉譯, 郭韋凡, 郭金龍, 黎家銘, 鄭偉凡	
13:10-13:15	1014	中鋼新建煉焦爐工程非破壞檢測作業	黃伯揚	
13:15-13:20	1022	基於 VGG19 深度學習模型之 ASME SA213-T12 鍋爐鋼金相複製膜影像分類	高全盛, 孫千茹, 陳雨玟	★
13:20-13:25	1028	傳統遠場渦電流與陣列式遠場渦電流於支撐板鄰近瑕疵之判別差異	余坤城, 陳明書, 袁翊峻	
13:25-13:30	1030	用於即時偵測車輛前照度的高動態成像系統	吳啓守, 林士翌, 蕭力瑋, 阮光鈞, 楊宗勳, 余業緯, 孫慶成	
13:30-13:35	1047	基於實際 Twyman-Green 干涉圖之曲率半徑深度學習估測: 不同卷積神經網路架構之比較	柯昱宏, 田春林, 黃翌宸	★
13:35-13:40	1059	熱交換管頻率選擇及評估方式之探討	鍾明雄, 陳秀易, 葉嘉興	
13:40-13:45	1060	被動式乾貯鋼筒腐蝕指示器的研發與應用	張佐民, 蔡坤釗, 董曉明, 葉俊平	★
13:45-13:50	1061	電磁超音波應用於超超臨界鍋爐水牆管材質劣化檢測	林士瑄, 高全盛, 林宏儒, 黃鴻鈞, 蔡武哲	★
13:50-13:55	1072	結合振動響應量測與高速影像分析之顆粒阻尼懸臂梁減振特性研究	沈立宗, 戴棟文	
13:55-14:00	1074	多維度聲音地圖建構之關鍵前端技術研究	謝佳妤, 沈志雄	

Time 時間	Paper ID 論文編號	Title 演講題目	Authors 作者	Competition 競賽
14:00-14:05	1077	以全反射渦旋光干涉術測量液體折射率	歐家安, 張紋綺, 林俊佑, 沈志雄	
14:05-14:10	1084	非監督式物理資訊神經網路於定量雷射超音波之缺陷評估	葉祐良, 楊哲化, 郭育誠	★
14:10-14:15	1085	聲波辨識應用於銲線技術金/銅異質鍵合之研究	葉雲鵬, 廖柏宇	
14:15-14:20	1097	鈹銅複合材料模具對射出成型冷卻時間之影響	黃建勝, 陳夏宗, 丁郁宏, 鄭年添, 施宥恩, 陳勁豪, 王祥瑋	★
14:20-14:25	1098	發電鍋爐保溫下腐蝕檢測技術建立與應用	洪敬傑, 翁德富	
14:25-14:30	1102	基於損耗模態共振製作鍍膜光纖CO2 氣體感測器	黃翌宸, 田春林, 柯昱宏	★
14:30-14:35	1105	基於七點三次自適應峰值定位之共光軸條紋投影非接觸式三維表面形貌量測	Rui-Hong Hong, Bo-Hao Huang, Nai-Jen Cheng	

Time 時間: 13:00-13:05, 10/15/2026

Location 地點: Multi-Functional Classroom 多功能教室

Paper ID 論文編號: 1003

電弧效應的生成與對材料組織的影響

陳奕成^{1*}, 鄭銘文¹

¹ 晟田科技工業股份有限公司特殊製程廠

*Corresponding Author: sj369@maicl.com

本文探討磁粒檢測法中，因採用直接磁化法進行檢測時，工件表面狀況及設備操作因素所造成之電弧損傷問題。引起電弧的方式有許多，直接接觸法的上磁方式可能就會因接觸不良而產生電弧，造成工件局部過熱、表面燒焦、燒結或其他異常損傷。一般非航太產業處置方式可能就是拋除或忽略，但航太產業嚴重時零件則需報廢。本文旨在透過硝酸腐蝕-化學檢測方式，用客觀方式來確認熱處理氧化層引發的電弧損傷狀況，驗證電弧對材料組織的影響。

Time 時間: 13:05-13:10, 10/15/2026

Location 地點: Multi-Functional Classroom 多功能教室

Paper ID 論文編號: 1013

傳統超音波檢測與相位陣列超音波檢測技術比較及其於焊道缺陷檢測之應用

陳偉譯¹, 郭韋凡¹, 郭金龍^{1*}, 黎家銘¹, 鄭偉凡²

¹ 台灣金屬材料品管有限公司

² 金屬工業研究發展中心

*Corresponding Author: tmqndt@tmqc.com.tw

本研究以實際焊道試片作為比較對象，分別採用傳統單一角度超音波檢測及相位陣列超音波檢測進行檢測，並比較兩種技術於檢測效率、涵蓋範圍、缺陷定位、影像呈現及資料分析等方面之差異。結果顯示，傳統 UT 具有設備成本低及操作簡便之優點，適合一般性焊道檢測；PAUT 則可透過多角度電子掃描及多維度影像呈現，提高複雜焊道之檢測涵蓋能力與缺陷定位能力。研究結果可作為不同工程條件下選擇適當超音波檢測技術之參考。

Time 時間: 13:10-13:15, 10/15/2026

Location 地點: Multi-Functional Classroom 多功能教室

Paper ID 論文編號: 1014

中鋼新建煉焦爐工程非破壞檢測作業

黃伯揚^{1*}

¹ 中國鋼鐵股份有限公司

*Corresponding Author: 182709@mail.csc.com.tw

中鋼公司新建一、二階煉焦爐及 CDQ 工程，工程內容涵蓋煉焦爐、乾式淬火設備（CDQ）及相關設備、管線與附屬設施，施工期間涉及大量設備組立及銲接作業，工程品質直接影響

後續設備運轉及生產穩定性。新建工程銲接接頭種類及數量繁多，施工過程須依工程圖面、施工規範及相關標準執行，從材料組立、銲前準備、預熱、銲接至銲後處理，各階段均需嚴格管控，稍有疏忽，即可能因組立偏差、銲接條件、殘留應力、備鑄不完全或銲工操作等因素，造成未熔合、未熔透、氣孔、夾渣、裂痕等銲接缺陷。為確保新建設備施工品質，中鋼非破壞檢驗單位配合工程進度及檢驗要求，依不同構件、材料及缺陷特性執行放射線檢測（RT）、超音波檢測（UT）、液滲檢測（PT）、磁粒檢測（MT）及目視檢測（VT）等非破壞檢測，針對重要銲接部位進行品質確認、缺陷判定及異常追蹤。透過新建工程階段之 NDT 檢測及缺陷分析，可及早發現銲接品質問題並督促改善，降低設備投入運轉後發生異常之風險，確保設備施工品質，為煉焦爐及 CDQ 設備後續長期運轉與穩定生產奠定良好基礎。

Time 時間: 13:15-13:20, 10/15/2026

Location 地點: Multi-Functional Classroom 多功能教室

Paper ID 論文編號: 1022

基於 VGG19 深度學習模型之 ASME SA213-T12 鍋爐鋼金相複製膜影像分類

高全盛¹, 孫千茹^{1*}, 陳雨玟¹

¹台灣電力股份有限公司綜合研究所

*Corresponding Author: u078648@taipower.com.tw

為提升傳統金相複製膜人工判讀之準確性與效率，本研究針對火力電廠鍋爐常用之 ASME SA213-T12 鋼材提出基於 VGG19 卷積神經網路之自動辨識系統。本研究對金相圖像進行前處理與局部裁切（Patch-based cropping），並利用模型自動辨識劣化等級；訓練過程配置適當學習率與充分迭代次數，並導入多數決投票機制。研究結果顯示，模型於 Patch 切片層級之準確率達 80.6%，經多數決投票整合後，整圖判定準確率提升至 94.4%。此外，本研究整合開發自動化人機介面與報告生成模組，建立由影像輸入至報告產出之端到端流程，為電廠設備大修與結構完整性評估提供高效且客觀之智慧化解決方案。

Time 時間: 13:20-13:25, 10/15/2026

Location 地點: Multi-Functional Classroom 多功能教室

Paper ID 論文編號: 1028

傳統遠場渦電流與陣列式遠場渦電流於支撐板 鄰近瑕疵之判別差異

余坤城¹, 陳明書¹, 袁翊峻^{1*}

¹ 鴻益科技工程檢驗有限公司

*Corresponding Author: yok315@gmail.com

遠場渦電流檢測 (Remote Field Testing, RFT) 常用於鐵磁性換熱器管, 但因線圈設計及物理原理限制, 當瑕疵位於支撐板附近時, 瑕疵訊號受結構物訊號干擾, 且缺乏周向位置資訊, 造成判讀困難。傳統 RFT 於支撐板鄰近區域易受結構訊號干擾, 且缺乏周向定位能力。RFA 可提升近支撐板瑕疵的辨識與周向定位, 縮小支撐板鄰近之判讀盲區, 透過特殊線圈設計, 使用周向多通道陣列與 C-scan 增加空間資訊, 可彌補傳統遠場探頭之不足。

Time 時間: 13:25-13:30, 10/15/2026

Location 地點: Multi-Functional Classroom 多功能教室

Paper ID 論文編號: 1030

用於即時偵測車輛前照度的高動態成像系統

吳啓守^{1*}, 林士罡¹, 蕭力瑋¹, 阮光鈞¹, 楊宗勳¹, 余業緯¹, 孫慶成^{1,2}

¹ 國立中央大學光電與工程學系

² 國立陽明交通大學電子物理學系

*Corresponding Author: deniswu1024@g.ncu.edu.tw

本文提出了一種用於快速檢測具有高對比度截止線的高動態照度的成像系統。本系統採用數位相機拍攝車輛頭燈的光型影像。經過影像處理和標定後, 可以精確地取得測量平面的照度

值，並透過改變曝光時間來提高系統測量的動態範圍。本文主要討論了兩種具代表性的規範：K-mark 和 ECE R113 B 級。結果表明，當照度值大於 2 lx 時，此成像系統的測量誤差在 $\pm 5\%$ 以內；當照度值小於 2 lx 時，測量誤差在 0.1 lx 以內。

Time 時間: 13:30–13:35, 10/15/2026

Location 地點: Multi-Functional Classroom 多功能教室

Paper ID 論文編號: 1047

基於實際 Twyman–Green 干涉圖之曲率半徑深度學習估測：不同卷積神經網路架構之比較

柯昱宏^{1*}, 田春林¹, 黃翌宸¹

¹逢甲大學電機工程學系

*Corresponding Author: charliecasper92@gmail.com

本研究提出一種基於深度學習之實際 Twyman-Green 圓形干涉圖曲率半徑估測方法，應用於 B270 玻璃基板形變之非接觸式量測。利用 Twyman-Green 干涉儀取得實際干涉圖，建立含 1,440 張影像之資料集，並以圓形干涉條紋分析方法計算曲率半徑作為模型訓練標籤。研究比較 VGG-based、VGG16、U-Net 及 ResU-Net 四種卷積神經網路之曲率半徑回歸效能，並以 MAE、MAPE、RMSE 及推論時間進行評估。結果顯示，VGG-based 模型之 MAE、MAPE 及 RMSE 分別為 2.0273 m、1.56% 及 2.9104 m，具有最佳估測表現，單次推論時間為 93.55 ms。進一步以 FFT 方法建立參考值，於四種曲率半徑條件下進行重複量測，VGG-based 平均預測值與 FFT 參考值之差異介於 0.0345–0.7476 m，顯示其具備由實際干涉圖估測曲率半徑之可行性。

Time 時間: 13:35-13:40, 10/15/2026

Location 地點: Multi-Functional Classroom 多功能教室

Paper ID 論文編號: 1059

熱交換管頻率選擇及評估方式之探討

鍾明雄^{1*}, 陳秀易¹, 葉嘉興¹

¹ 承標工業有限公司(NDE-Pro)

*Corresponding Author: jong.nde@msa.hinet.net

熱交換器檢測廣泛應用於發電、石油、化工等領域，是維持營運的重要組件，一旦破損將造成營運的重大延宕。熱交換器會發生腐蝕、沖蝕、磨耗、龜裂等各類瑕疵。業界依引用之評估設定方式有所差異，對於沖/腐蝕型式之缺陷常使用相位 vs 缺陷深度曲線，這種曲線常用於孔蝕、沖腐蝕等缺陷之評估。因規範所列標準管上之缺陷係模擬孔蝕所製成，然而一般使用者卻將此曲線應用於所有類型之缺陷。本論文探討各工業規範之標準管人工瑕疵以及曲線設定之差異，歸納檢測誤差原因以及較適切的頻率選用及關係曲線設定方式。

Time 時間: 13:40-13:45, 10/15/2026

Location 地點: Multi-Functional Classroom 多功能教室

Paper ID 論文編號: 1060

被動式乾貯鋼筒腐蝕指示器的研發與應用

張佐民^{1*}, 蔡坤釗¹, 董曉明¹, 葉俊平¹

¹ 國家原子能科技研究院材料研究所

*Corresponding Author: joeming@nari.org.tw

本研究針對臨海用過核子燃料乾式貯存設施中，奧氏體不銹鋼密封鋼筒所面臨之氯離子誘發應力腐蝕破裂（Chloride-Induced Stress Corrosion Cracking, CISCC）風險，開發一套小型、輕量化(長、寬、高: 20 cm × 12 cm × 1 cm，重量:1kg)且不須外加電源的被動式乾貯鋼筒腐蝕指

示器。現行鋼筒檢測技術受限於混凝土護箱內部通道狹窄、高溫及強輻射場，導致技術難度極高且成本高昂。本乾貯鋼筒腐蝕指示器，使用四點加載應力的設計，對密封鋼筒所使用的不銹鋼板材試樣品施加恆定應力，依據 ASTM G39 規範的模擬運轉中密封鋼筒鋼材的受力。試樣品在嵌入指示器後，可直接置入到混凝土護箱的進氣口深處的密封鋼筒位置，此時樣品所處的環境、置備的材料與所受到的應力皆與運轉中的密封鋼筒鋼材一致，符合學理上評估乾貯密封不銹鋼筒之 CISCC 安全度評估的三因素(環境、材料與應力)。指示器使用時可週期性取出對試樣品進行檢測(NDT、重量或機械測試…等)後再置入，作為判斷運轉中密封鋼筒表面劣化行為的依據。

Time 時間: 13:45-13:50, 10/15/2026

Location 地點: Multi-Functional Classroom 多功能教室

Paper ID 論文編號: 1061

電磁超音波應用於超超臨界鍋爐水牆管材質劣化檢測

林士瑄^{1*}, 高全盛², 林宏儒¹, 黃鴻鈞¹, 蔡武哲¹

¹台灣電力公司電力修護處

²台灣電力公司綜合研究所

*Corresponding Author: u777829@taipower.com.tw

電磁超音波應用於鍋爐水牆管材質劣化評估，可有效解決傳統超音波耦合不穩定及縱波波式對材質劣化檢測靈敏度不足的瓶頸。研究結果顯示，多重回波增益衰減量與管材降伏強度呈負相關性。當材質劣化進入老化區間，回波衰減越是明顯，嚴重者甚至回波數不足。適合應用於鍋爐水牆管材質劣化快篩，進而達到大面積檢測之目的。

Time 時間: 13:50-13:55, 10/15/2026

Location 地點: Multi-Functional Classroom 多功能教室

Paper ID 論文編號: 1072

結合振動響應量測與高速影像分析之顆粒阻尼 懸臂梁減振特性研究

沈立宗^{1*}, 戴棟文¹

¹ 國立宜蘭大學機械與機電工程學系

*Corresponding Author: ltsheng@niu.edu.tw

顆粒阻尼器可藉由顆粒與腔體間之相對運動、碰撞與摩擦耗散結構振動能量，其減振效果與顆粒運動狀態密切相關。本研究以自由端配置顆粒阻尼器之懸臂梁為對象，在垂直穩態激振下結合加速度響應量測與高速影像分析，探討不同填充率與腔體方向對振動傳遞及顆粒動態行為之影響。結果顯示，附加質量雖使共振頻率下降，但主要減振作用來自顆粒相對運動、動量交換與碰撞耗能。隨激振強度提高，顆粒由受限運動逐步轉為脫離、回落及壁面碰撞，使振動傳遞率顯著降低；若上壁碰撞增加或下壁接觸時機改變，部分配置之減振效能則下降。結構振動響應與顆粒碰撞型態之同步量測，可作為辨識阻尼工作狀態與顆粒阻尼器設計之參考。

Time 時間: 13:55-14:00, 10/15/2026

Location 地點: Multi-Functional Classroom 多功能教室

Paper ID 論文編號: 1074

多維度聲音地圖建構之關鍵前端技術研究

謝佳妤^{1*}, 沈志雄¹

¹ 國立彰化師範大學機電工程學系

*Corresponding Author: s1251042@gm.ncue.edu.tw

聲音事件辨識與聲源方向估測若分別於不同時間區段取得，可能造成事件類別與空間資訊於整合時產生錯配。本文提出一套以同步多通道音訊為核心的聲音感知前端架構，使聲音事件與方向資訊可由同次聲音觀測中同步取得。系統以同步音訊為共同資料來源，分別進行空間特徵分析與聲音事件辨識，並利用 GCC-PHAT 估測到達時間差取得方向資訊，結合 TinyCNN 與警報聲特徵偵測器取得事件特徵。兩路結果依共同時間基準整合為結構化聲學事件。實作以 FPGA/ARM 異質運算系統與方陣式 MEMS 麥克風陣列驗證，TinyCNN 準確率達 91.41%，八方向正確輸出比例為 82.50%；347 筆 RAW 音訊經決策融合後，分類準確率由 78.67% 提升至 91.93%。

Time 時間: 14:00-14:05, 10/15/2026

Location 地點: Multi-Functional Classroom 多功能教室

Paper ID 論文編號: 1077

以全反射渦旋光干涉術測量液體折射率

歐家安^{1*}, 張姝綺¹, 林俊佑¹, 沈志雄¹

¹ 國立彰化師範大學機電工程學系

*Corresponding Author: s1251051@gm.ncue.edu.tw

本研究結合偏振渦旋光干涉術與全反射原理，開發一套液體折射率量測系統。當待測液體的濃度改變時，其折射率亦隨之變化，使渦旋光束經全反射後的兩個正交偏振分量產生相位差變化，進而造成干涉圖案中央暗紋旋轉。因此，透過影像分析精確量測暗紋的旋轉角度，即可求得相位差變化，並據以計算待測溶液折射率。本研究比較質心法、主成分分析法（principal component analysis, PCA），以及質心導引多特徵峰形融合相關法（correlation method）三種暗紋角度計算方法。結果顯示，不同濃度溶液所形成的干涉暗紋具有明顯的角度位移，且三種方法皆能有效反映折射率的變化趨勢。最後以均方根誤差（root mean square error, RMSE）與穩定性等指標評估三種方法的量測表現，並探討其應用於本量測系統的適用性。

Time 時間: 14:05-14:10, 10/15/2026

Location 地點: Multi-Functional Classroom 多功能教室

Paper ID 論文編號: 1084

非監督式物理資訊神經網路於定量雷射超音波之缺陷評估

葉祐良^{1*}, 楊哲化¹, 郭育誠¹

¹國立臺北科技大學製造科技研究所

*Corresponding Author: mlbflight9031@gmail.com

定量雷射超音波中，多模態導波與邊界反射重疊，使缺陷輪廓難以判讀。本研究以物理資訊神經網路估計主要傳播波場作為參考，分析量測與參考之差，融合四方位結果建立缺陷圖。並設計自適應感興趣區域（ROI）回饋流程，由初始圖自動擷取疑似缺陷區，排除區內訓練資料後重估參考並更新缺陷圖。以長方形、菱形與不規則形各四種深度，共十二片試片驗證，可呈現不規則缺陷的內凹輪廓。以交集聯集比衡量預測與試片缺陷範圍的重疊，三類平均依序為 61.5%、63.2%及 46.4%（100%為完全重合）。自適應 ROI 回饋後，三類缺陷相對背景的平均能量對比均提高，範圍改善則因形狀而異。神經網路訓練不使用輪廓標籤，形貌由實測波場取得。

Time 時間: 14:10-14:15, 10/15/2026

Location 地點: Multi-Functional Classroom 多功能教室

Paper ID 論文編號: 1085

聲波辨識應用於鐸線技術金/銅異質鍵合之研究

葉雲鵬^{1*}, 廖柏宇¹

¹國立台灣科技大學

*Corresponding Author: ypyeh@mail.ntust.edu.tw

本研究導入聲發射 (Acoustic Emission, AE) 技術量測電子封裝鐸線技術金/銅第一接點之鍵合動態，並以功率譜密度(Power Spectral Density, PSD)、載波包絡與聲譜圖(Spectrogram)解析同質及異質界面之時頻特徵。結果顯示，金之間的鍵合皆出現約 63 kHz 基頻及 126、189 kHz 之第二、第三諧波；當其鍵合時間由 100 ms 增加至 200 ms 時，高次諧波明顯增強，反映界面接觸、滑移、摩擦與塑性變形演變所造成的非線性振動能量重分配。異質的金銅鍵合，則於 200 ms 時則以約 126.147 kHz 為較突出之主導頻率，顯示異質界面具有不同的動態傳遞特性。研究之結果說明金球鍵合並非僅為單純的壓接，而是具時間與材料依賴性的非線性過程，並表示 AE 感測器應用於即時監測半導體之鐸線封裝製程之潛力。

Time 時間: 14:15-14:20, 10/15/2026

Location 地點: Multi-Functional Classroom 多功能教室

Paper ID 論文編號: 1097

鈹銅複合材料模具對射出成型冷卻時間之影響

黃建勝^{1,2,3*}, 陳夏宗^{1,2}, 丁郁宏^{1,2}, 鄭年添^{1,2}, 施宥恩¹, 陳勁豪¹,
王祥瑋¹

¹ 中原大學機械工程學系

² 中原大學智慧製造研發中心

³ 中原大學熱管理研發中心

*Corresponding Author: jshuang@cycu.edu.tw

本研究探討射出成型模具以鈹銅局部替換 P20 鋼模具對冷卻時間之影響，以厚度(d)=3 mm 之 PP 塑膠料件為分析對象，在水路深度(W)=16 mm 與水路管徑(D)=8 mm 條件下，設定不同水路間距(P)與水路深度之幾何比例 (P/W)=1.25、1.50 及 1.75，以及不同對流熱傳遞係數(H)=2,500、5,000 與 10,000 W/m²·K，比較 P20 鋼模具與鈹銅複合材料模具之冷卻性能。結果顯示，在不同幾何比例與不同對流熱傳遞係數條件下，使用鈹銅複合材料模具之冷卻時間皆低於 P20 鋼模具。以 P/W =1.25 為例，冷卻時間改善率約為 17.15%至 19.01%，顯示局部導入具高熱傳導性質之鈹銅可有效改善模具熱傳性能並縮短冷卻時間。

Time 時間: 14:20-14:25, 10/15/2026

Location 地點: Multi-Functional Classroom 多功能教室

Paper ID 論文編號: 1098

發電鍋爐保溫下腐蝕檢測技術建立與應用

洪敬傑^{1*}, 翁德富¹

¹ 中國鋼鐵股份有限公司智財與檢測技術處

*Corresponding Author: 175901@mail.csc.com.tw

保溫層下腐蝕 (Corrosion Under Insulation, CUI) 具高度隱蔽性，易導致高溫管線局部腐蝕減薄，甚至引發突發性破裂，為工業設備完整性管理之重要風險來源。本文以發電鍋爐之飼水保溫管線破損事故為案例，評估並測試多項非破壞檢測技術，包括紅外線熱像檢測 (IRT)、脈衝渦電流檢測 (PEC)、輪廓射線照相 (RT Profile) 及超音波厚度量測 (UT) 等，透過實務測試與驗證，分析各技術之特性與適用性，整合各方法優勢，據以建立快速辨識與確認管線潛在腐蝕之檢測策略。同時參考 API 規範，綜合管線溫度現況、環境條件與設備特性，建立 CUI 風險分級與檢測策略，協助維護單位針對具外層保溫材料之高溫管線制定檢查計畫與風險評估矩陣，建立具實務可行性之管線檢查與風險管理機制，強化設備完整性、降低維護成本並提升生產安全。

Time 時間: 14:25-14:30, 10/15/2026

Location 地點: Multi-Functional Classroom 多功能教室

Paper ID 論文編號: 1102

基於損耗模態共振製作鍍膜光纖 CO₂ 氣體感測器

黃翌宸¹, 田春林^{1*}, 柯昱宏¹

¹ 逢甲大學電機工程系

*Corresponding Author: cltien@fcu.edu.tw

本研究採用損耗模態共振 (Lossy Mode Resonance, LMR) 結合機械側磨光纖技術，將薄膜沉積在側磨光纖上來製作 LMR 型的光纖氣體感測器。單面拋光側磨光纖的製作是透過自製的光纖側磨拋光機製作而成，並在光纖拋光平面上使用高真空電子鎗蒸鍍技術結合離子輔助沉積技術鍍上氧化鎢(WO_3)薄膜，透過控制拋光後的側磨光纖殘留厚度和金屬氧化物薄膜的厚度，有助於建立損耗模態共振的氣體感測機制。二氧化碳(CO_2)氣體感測實驗是使用單模拋光光纖(SMF)在拋光平面上鍍製氧化鎢薄膜來感測 CO_2 氣體濃度。實驗結果得到鍍膜光纖的 CO_2 氣體感測器靈敏度為 58 pm/ppm，線性擬合係數 R^2 為 0.95。

Time 時間: 14:30-14:35, 10/15/2026

Location 地點: Multi-Functional Classroom 多功能教室

Paper ID 論文編號: 1105

基於七點三次自適應峰值定位之共光軸條紋投影非接觸式三維表面形貌量測

Rui-Hong Hong^{1*}, Bo-Hao Huang¹, Nai-Jen Cheng¹

¹Institute of Photonics Engineering, National Kaohsiung University of Science and Technology

*Corresponding Author: fl14155155@nkust.edu.tw

共光軸條紋投影藉由待測物沿 Z 軸掃描時的條紋清晰度變化，估計各像素最佳對焦位置並重建三維形貌。直接最大值法受 Z 軸取樣步距限制，七點二次擬合則較難描述局部不對稱峰形。本研究建立七點三次自適應峰值定位，利用二階導數、搜尋範圍與端點值篩選局部最大值；若未通過條件，依序採用中心三點局部拋物線及直接最大值。以霧面陶瓷塊規斜面驗證相位判定法與多步相位移法所得振幅資料。結果顯示，此流程可補足三次曲線未通過條件的像素，使共同有效像素皆由曲線估測取得峰值位置，並降低部分剖面的平面殘差起伏，可作為共光軸條紋投影非接觸式三維表面形貌量測之峰值定位方法。

EP: English Poster Session, 英文海報競賽

Session Chairs: Ping-Sheng Huang, Jin-Jhy Jeng

主持人: 黃炳森, 鄭錦智

Time 時間 : 15:12-16:07, 10/15/2026

Location 地點 : Multi-Functional Classroom 多功能教室

Time 時間	Paper ID 論文編號	Title 演講題目	Authors 作者	Competition 競賽
15:12-15:17	1004	AI-Based Weld Defect Classification from Ultrasonic A-Scan Images: Taguchi Optimization	Yi-Min Lai, Zong-Jun Wu, Yu-Hsuan Lin, Cheng-Feng Wang, Ming-Che Lin	
15:17-15:22	1015	Allan Deviation-Based Optimization of Sensor Signal Processing for Optical Gas Measurement	Yu-Cheng Lin, An-Chi Wei, Jyh-Rou Sze	
15:22-15:27	1026	Improving Ultrasonic Inspection Reliability of As-built WAAM Components with Rough Surfaces Using Solid Composite Couplants	Shang-Pang Yu, Pei-Gang Tong	
15:27-15:32	1031	Wide-Angle Edge Detection Metasurface for Infrared with Hexagonal Arrangement	Po-Yu Wu, Chun-Yuan Fan	★
15:32-15:37	1042	LocAu-PS Microarrays with Wettability-Driven Droplet Confinement and Optimized SERS Hot-Spots for Micro-Volume Bioanalysis	Jung-Yen Hsu, Chia-Wen Tsao, Nai-Jen Hung	
15:37-15:42	1071	Measurement and Evaluation of Wavelength-Dependent Imaging Aberrations in Line-Image Holograms	Pin-Cheng Lin, Min-Hsin Chan, Bo-Siang Jhong, Cheng-Ting Huang, Jing-Heng Chen	
15:42-15:47	1076	Automated wide-field imaging in lens-free digital holography	Chih-Cheng Hsu, Chung-Hsuan Huang, Chau-Jern Cheng, Han-Yen Tu	
15:47-15:52	1078	Effect of Surface Morphology on the Optimal Polishing Depth in SiO ₂ Abrasive Polishing of Rough Silicon Wafers: A Molecular Dynamics Study	Minheon Chu, Sungmin Yoon	

Time 時間	Paper ID 論文編號	Title 演講題目	Authors 作者	Competition 競賽
15:52- 15:57	1081	Axial Depth Position Mapping in Coaxial Shallow-Depth-of-Field Fringe Projection Based on Phase-Partitioned Focus Determination	Tzu-Chun Lin, Bo-Hao Huang, Nai-Jen Cheng, Wei-Hung Su	
15:57- 16:02	1089	A Data Driven Framework for Frequency Dependent Insertion Loss Prediction and Acoustic Material Screening	Jonghwan Park, Boris I, Jiwon Park, Do-Kyung Pyun, Jaesun Lee	★
16:02- 16:07	1090	Mode III Fracture Mechanics Parameters Measurement of 3D-Printing Structures using Optical Interferometry	Po-Yuan Kuo, Jiong-Shiun Hsu	

Time 時間: 15:12–15:17, 10/15/2026

Location 地點: Multi-Functional Classroom 多功能教室

Paper ID 論文編號: 1004

AI-Based Weld Defect Classification from Ultrasonic A-Scan Images: Taguchi Optimization

Yi-Min Lai¹, Zong-Jun Wu¹, Yu-Hsuan Lin¹, Cheng-Feng Wang²,
Ming-Che Lin^{1*}

¹Department of Mechanical Engineering, National Kaohsiung University of Science and Technology

²CTCI Machinery Corporation

*Corresponding Author: limit168@nkust.edu.tw

Reliable inspection of high-pressure hydrogen storage tanks requires accurate nondestructive testing (NDT). Although ultrasonic testing (UT) offers safety, efficiency, and environmental advantages over radiographic testing, manual A-scan interpretation remains subjective and error-prone. This study integrates conventional UT with deep-learning-based image recognition using VisLab to classify welds into three categories: crack defects, porosity defects, and defect-free welds. A Taguchi L18 orthogonal array optimizes eight experimental factors. Analysis of variance (ANOVA) identifies network model (47.06%) and learning rate (17.85%) as the dominant factors. The optimal

configuration improves classification accuracy from 38.60% to 90.67%, achieving 93.15% recall and a 91.89% F-measure. The proposed approach provides a reliable, cost-effective solution for automated weld inspection and industrial quality assurance.

Time 時間: 15:17–15:22, 10/15/2026

Location 地點: Multi-Functional Classroom 多功能教室

Paper ID 論文編號: 1015

Allan Deviation-Based Optimization of Sensor Signal Processing for Optical Gas Measurement

Yu-Cheng Lin¹, An-Chi Wei^{2*}, Jyh-Rou Sze³

¹Opto-Mechatronics Engineering, Department of Mechanical Engineering, National Central University

²Department of Mechanical Engineering, National Central University

³National Center for Instrumentation Research, National Institutes of Applied Research

*Corresponding Author: acwei@ncu.edu.tw

Gas density uniformity in semiconductor process chambers directly affects process stability and product quality. However, conventional systems primarily control pressure and flow rate and provide limited information on local density variations. This study develops an automated optical measurement system using a 533 nm green laser, a prism assembly, and a position sensing detector (PSD) to measure the positional change of a laser beam after it passes through a gas-filled chamber. The X1 and X2 output voltages of the PSD are acquired using an Arduino. Measurement stability is evaluated by Allan deviation to distinguish short-term random noise from long-term drift at different averaging times. The minimum Allan deviations of the X1 and X2 channels are 4.88×10^{-5} V at 7.9 s and 4.16×10^{-5} V at 8.9 s, respectively. These results indicate that an averaging time of approximately 8 s provides the best measurement stability. At longer averaging times, the Allan deviation increases, suggesting that low-frequency drift or random-walk processes begin to dominate the measurement error. The results demonstrate an approach using Allan deviation to determine the optimum averaging time of PSD signals for subsequent conversion of beam displacement into gas refractive index and density.

Time 時間: 15:22–15:27, 10/15/2026

Location 地點: Multi-Functional Classroom 多功能教室

Paper ID 論文編號: 1026

Improving Ultrasonic Inspection Reliability of As-Built WAAM Components with Rough Surfaces Using Solid Composite Couplants

Shang-Pang Yu^{1*}, Pei-Gang Tong²

¹Department of Mechanical Engineering, National Taipei University of Technology

²Graduate Institute of Manufacturing Technology, National Taipei University of Technology

*Corresponding Author: ysp@ntut.edu.tw

Wire and arc additive manufacturing components typically exhibit stepped and rough as-built surfaces, which pose challenges for ultrasonic testing and often require surface machining prior to inspection. This study investigates solid carbon-based wax composite couplants for direct ultrasonic inspection of rough WAAM surfaces without additional surface finishing. Paraffin wax was selected as the base matrix and modified with carbon nanotubes, carbon powder, and graphene. Ultrasonic attenuation tests showed that 0.8 wt.% graphene provided the best coupling performance, increasing the back-wall echo amplitude from 43 to 81 dB. The optimized graphene–wax couplant was further validated using WAAM specimens containing lack of fusion, slag inclusion, and porosity, demonstrating reliable defect detection on rough as-built surfaces. These results indicate that the proposed composite couplant can reduce surface preparation requirements and provide a practical approach for integrating ultrasonic inspection into WAAM quality assurance.

Time 時間: 15:27–15:32, 10/15/2026

Location 地點: Multi-Functional Classroom 多功能教室

Paper ID 論文編號: 1031

Wide-Angle Edge Detection Metasurface for Infrared with Hexagonal Arrangement

Po-Yu Wu¹, Chun-Yuan Fan^{1,2*}

¹Graduate Institute of Electro-Optical Engineering, National Taiwan University of Science and Technology

²Electronic and Computer Engineering, National Taiwan University of Science and Technology

*Corresponding Author: poyuwu@mail.ntust.edu.tw

We present a compact infrared metasurface with a hexagonal lattice configuration for real-time, all-optical wide-angle edge detection within the 1300–1550 nm spectral range. By tailoring the local optical response of individual meta-atoms and exploiting lattice symmetry, the spatial transfer function is engineered to realize an isotropic optical Laplacian differentiator. Compared to conventional square lattices, the proposed hexagonal arrangement provides enhanced rotational symmetry and higher sampling density, resulting in superior angular robustness. Full-wave numerical simulations demonstrate an average contrast ratio of approximately 65% across the entire O–C band. Furthermore, the high-symmetry design ensures polarization-insensitive operation and maintains robust edge-enhancement performance at incident angles up to 30° in the substrate with minimal phase deviation. By executing parallel computing entirely in the analog optical domain without any digital post-processing, this design offers significant potential for next-generation high-speed machine vision, intelligent remote sensing, and real-time biomedical imaging.

Time 時間: 15:32–15:37, 10/15/2026

Location 地點: Multi-Functional Classroom 多功能教室

Paper ID 論文編號: 1042

LocAu-PS Microarrays with Wettability-Driven Droplet Confinement and Optimized SERS Hot-Spots for Micro-Volume Bioanalysis

Jung-Yen Hsu^{1*}, Chia-Wen Tsao¹, Nai-Jen Hung¹

¹Department of Mechanical Engineering, National Central University

*Corresponding Author: eddison609@gmail.com

Raman spectroscopy's molecular specificity and label-free nature [1], is an indispensable tool in the fields of biomedicine, materials science, and chemical analysis [2]. However, Raman scattering is inherently limited by its weak signal intensity, necessitating the use of Surface-Enhanced Raman Spectroscopy (SERS) for amplification. To address this, this study developed a micro-array platform composed of gold-modified porous silicon (LocAu-PS) optimized for micro-analysis. The device offers exceptional spatial positioning and detection stability, significantly enhancing the flexibility and reliability of the analytical process. By leveraging the substantial surface energy contrast between the hydrophobic porous silicon background and the hydrophilic metallic sites, a unique wettability pattern was constructed. This design implements a droplet confinement strategy that not only anchors microliter reagents precisely within the sensing zones to reduce costs but also drastically improves target search efficiency and sensing sensitivity by constraining the detection area to microscale spots. The LocAu-PS micro-arrays were fabricated using the previously developed contact deposition method to graft gold nanoparticles (AuNPs) onto the substrate (Fig.1a), [3] Through parameter optimization a deposition height of 150 μm and a volume of 2 μL were identified as the optimal combination (Fig.1b), resulting in sensing sites with a diameter of approximately 618 μm that stably confine 1 μL droplets via strong wettability contrast. To overcome the issue of sparse hot-spot distribution, DMSO was introduced to modulate nanoparticle morphology [4]. The results demonstrated that increasing DMSO concentration transformed the AuNPs from isolated clusters into dense regions, significantly increasing the surface coverage from 47.0% to 71.5% (at 10% DMSO) (Fig.2a). This transition effectively strengthened plasmonic hot spots, leading to a substantial enhancement in the SERS signal intensity of Methylene Blue (MB) (Fig.3). The platform was further utilized for capturing Circulating Tumor Cells (CTCs) by implementing a droplet-based regional

functionalization strategy. This approach enables independent antibody modification of individual LocAu-PS sites without cross-interference (Fig.2b), allowing for simultaneous multiplexed CTC testing while minimizing reagent costs. To verify the platform's versatility, cross-equipment validation was performed using 488 nm and 532 nm laser systems (Fig.3). While both wavelengths successfully generated characteristic signals at high MB concentrations, the 488 nm excitation exhibited superior sensitivity at lower concentrations, achieving a detection limit (LOD) of 10^{-5} M. In A549 cell analysis (Fig.4a), the 532 nm laser triggered significant autofluorescence from endogenous cellular components, which compromised spectral resolution. In contrast, 488 nm excitation effectively suppressed background interference and improved the signal-to-noise ratio (SNR). Consequently, 488 nm was selected for molecular fingerprinting. Following EGFR antibody modification, the device demonstrated exceptional single-cell detection capability with clearly discernible characteristic peaks, confirming its potential for high-reproducibility clinical diagnostics and molecular identification (Fig. 4b). The LocAu-PS microarray platform developed in this study enables high-sensitivity detection of high-cost and rare samples via droplet confinement, significantly reducing analysis costs. By constraining the detection area to the micro-scale, the platform further enhances overall analytical efficiency. Validated across multiple instrumental setups, the device demonstrates exceptional analytical performance and robust stability.

Time 時間: 15:37–15:42, 10/15/2026

Location 地點: Multi-Functional Classroom 多功能教室

Paper ID 論文編號: 1071

Measurement and Evaluation of Wavelength-Dependent Imaging Aberrations in Line-Image Holograms

Pin-Cheng Lin¹, Min-Hsin Chan¹, Bo-Siang Jhong¹, Cheng-Ting Huang²,
Jing-Heng Chen^{1*}

¹Department of Photonics, Feng Chia University

²Program in Electrical and Communications Engineering, Feng Chia University

*Corresponding Author: jhchen@fcu.edu.tw

Based on Meier's aberration theory, this study investigates the effects of varying the reconstruction wavelength on holograms recorded at 520 nm. Experimental results demonstrate that under 640 nm reconstruction, the transverse magnification approaches 1, while the longitudinal magnification is 0.8. Simulations reveal that distortion is the most significant aberration during wavelength deviation, laying a foundation for full-spectrum holographic aberration correction.

Time 時間: 15:42–15:47, 10/15/2026

Location 地點: Multi-Functional Classroom 多功能教室

Paper ID 論文編號: 1076

Automated Wide-Field Imaging in Lens-Free Digital Holography

Chih-Cheng Hsu¹, Chung-Hsuan Huang¹, Chau-Jern Cheng²,
Han-Yen Tu^{1*}

¹Department of Electrical Engineering, Chinese Culture University

²Institute of Electro-Optical Engineering, National Taiwan Normal University

*Corresponding Author: dhy@ulive.pccu.edu.tw

Lens-free digital holography provides wide-field imaging through a compact optical configuration, yet its imaging area remains limited by the sensor dimensions. Samples exceeding the sensor area therefore necessitate multiple overlapping holograms to be stitched. Reliable registration is difficult because sensor noise, twin-image artifacts, and repetitive interference fringes can impair feature matching. This study introduces a controlled verification workflow using additive Gaussian white noise to build holographic benchmark datasets with known spatial ground truth under light, moderate, and severe noise conditions. A detector-free dense matcher, Generalizable Image Matcher with Dense Kernelized Matching, is applied to establish correspondences between adjacent holograms. The proposed workflow allows quantitative evaluation of registration robustness across different noise severity levels.

Time 時間: 15:47–15:52, 10/15/2026

Location 地點: Multi-Functional Classroom 多功能教室

Paper ID 論文編號: 1078

Effect of Surface Morphology on the Optimal Polishing Depth in SiO₂ Abrasive Polishing of Rough Silicon Wafers: A Molecular Dynamics Study

Minheon Chu¹, Sungmin Yoon^{1*}

¹School of Mechanical Engineering, Changwon National University

*Corresponding Author: yoonsm@changwon.ac.kr

Polishing depth is a major process parameter in nanoscale silicon wafer polishing. A previous study investigated the effect of polishing depth in rough silicon wafer polishing and identified 2.6 nm as the optimal polishing depth. Since surfaces with similar average surface roughness can exhibit different surface morphologies, the influence of surface morphology on the optimal polishing depth warrants further investigation. In this study, the molecular dynamics simulation methodology was based on the previous study. Two rough silicon wafer models with the same average surface roughness but different surface morphologies were used to examine the morphological dependence of the optimal polishing depth.

Time 時間: 15:52–15:57, 10/15/2026

Location 地點: Multi-Functional Classroom 多功能教室

Paper ID 論文編號: 1081

Axial Depth Position Mapping in Coaxial Shallow-Depth-of-Field Fringe Projection Based on Phase-Partitioned Focus Determination

Tzu-Chun Lin^{1*}, Bo-Hao Huang¹, Nai-Jen Cheng¹, Wei-Hung Su²

¹Institute of Photonics Engineering, National Kaohsiung University of Science and Technology

²Department of Material Science and Optoelectronic Engineering, National Sun Yat-Sen University

*Corresponding Author: F114155179@nkust.edu.tw

This study proposes a phase-partitioned focus determination method for a coaxial shallow-depth-of-field fringe projection system, enabling depth-dependent focus determination using a single fringe image at each scanning position. The phase is first extracted from the spectrum of a reference fringe pattern, and each fringe period is divided into bright, gray, and dark regions. The optimal-focus image index is then determined using the intensity peak, gradient peak, and intensity valley for the respective regions. Depth-dependent intensity trend correction, dual-layer validity masks, and turning-magnitude thresholds are further employed to reduce misidentification caused by background interference and noise. This paper focuses on phase partitioning, focus-candidate screening, and the mapping between the optimal-focus position and the corresponding z-axis scanning position.

Time 時間: 15:57–16:02, 10/15/2026

Location 地點: Multi-Functional Classroom 多功能教室

Paper ID 論文編號: 1089

A Data Driven Framework for Frequency Dependent Insertion Loss Prediction and Acoustic Material Screening

Jonghwan Park¹, Boris I², Jiwon Park¹, Do-Kyung Pyun^{3*}, Jaesun Lee^{3*}

¹Department of Mechanical Engineering, Changwon National University

²DNA+ Research Institute, Changwon National University

³School of Mechanical Engineering, Changwon National University

*Corresponding Author: dpyun@changwon.ac.kr, jaesun@changwon.ac.kr

Insertion loss (IL) provides a system-level measure of noise-control performance, but experimental assessment becomes expensive when material type, density, thickness, and layer arrangement are varied. This study presents a measurement-driven machine-learning framework for predicting complete frequency-dependent IL spectra and screening acoustic material configurations before final

testing. The database comprised 113 absorber, barrier, and absorber-barrier configurations measured in a fixed two-compartment chamber. Fourteen one-third-octave-band IL values from 250 to 5000 Hz were retained for each configuration. Material type, absorber planar density, barrier thickness, and barrier specific gravity were used to describe each case. Group-aware splitting prevented related configurations from appearing in both model fitting and evaluation. Sixteen regression algorithms were compared under the same grouped cross-validation procedure, and the five leading models were optimized by randomized hyperparameter search. Optimized Gradient Boosting Regression achieved the lowest cross-validation error and was selected as the final predictor. On the held-out test subset, the model achieved a coefficient of determination of 0.981, a root mean squared error of 1.670 dB, and a mean absolute error of 1.228 dB. Representative predictions reproduced the broadband variation of measured IL and the dominant effect of barrier-containing configurations. The results support ensemble learning as a practical means of capturing nonlinear relationships between accessible material descriptors and installed acoustic performance within the measured domain. The framework is intended for rapid ranking and screening rather than replacement of final experimental verification.

Time 時間: 16:02–16:07, 10/15/2026

Location 地點: Multi-Functional Classroom 多功能教室

Paper ID 論文編號: 1090

Mode III Fracture Mechanics Parameters Measurement of 3D-Printing Structures Using Optical Interferometry

Po-Yuan Kuo¹, Jiong-Shiun Hsu^{1*}

¹Department of Power Mechanical Engineering, National Formosa University

*Corresponding Author: jshsu@nfu.edu.tw

3D printing structures have been increasingly applied in various fields, making the mechanical behaviours of these structures under external loads a growing research topic. This study employs an optical interferometry to measure and study the fracture mechanics parameters of 3D printing structures with edge cracks with different printing methods, i.e. grid, lighting, and triangular infills, under periodically dynamic loads.

E-SS1: Advanced Optical Metrology, 先進光學 量測技術

Session Chair: Hung-Lin Hsieh

主持人: 謝宏麟

Time 時間 : 13:00-14:48, 10/15/2026

Location 地點 : Lo Chia-Lun Lecture Hall 羅家倫講堂

Time 時間	Paper ID 論文編號	Title 演講題目	Authors 作者
13:00-13:18	1011	Radially Polarized Beam-Based Dual-Wavelength Interferometry for Surface Profile Measurement	Tzu-Hsiang Chang, Cheng-Che Hsieh, Jing-Heng Chen, Kun-Huang Chen
13:18-13:36	1027	Large-Area Wafer Surface Topography Measurement Based on Shadow Moiré and Spatial Averaging	Yan-Cheng Hu, Wei Chen, Ting-Hao Cao, Ju-Yi Lee
13:36-13:54	1036	Measurement Performance of Reflector-Aided LiDAR Localization for a High-Payload Autonomous Mobile Robot	Chen-Fei Yang, Yi-Chuan Tseng, Po Ting Lin
13:54-14:12	1049	Application of a Fizeau Interferometer Based on Electro-Optic Modulation and Error-Suppressed Phase Demodulation for Wafer Surface Topography Measurement	Jia-Ying Li, Yu-Yi Hsieh, Hung-Lin Hsieh
14:12-14:30	1073	Polarization-Multiplexed Single-Shot Dual-Wavelength Lens-Free Holographic Imaging	Chung-Hsuan Huang, Chau-Jern Cheng, Han-Yen Tu
14:30-14:48	1099	In-Plane Displacement Measurement Using a Reflective Grating Interferometer	Kun-Huai Shen, Chun-Pin Chen, Hung-Lin Hsieh

Time 時間: 13:00–13:18, 10/15/2026

Location 地點: Lo Chia-Lun Lecture Hall 羅家倫講堂

Paper ID 論文編號: 1011

Radially Polarized Beam-Based Dual-Wavelength Interferometry for Surface Profile Measurement

Tzu-Hsiang Chang¹, Cheng-Che Hsieh¹, Jing-Heng Chen²,
Kun-Huang Chen^{1*}

¹Department of Electrical Engineering, Feng Chia University

²Department of Photonics, Feng Chia University

*Corresponding Author: chenkh@fcu.edu.tw

A dual-wavelength interferometric method based on a radially polarized beam is proposed for full-field surface profile measurement. A linearly polarized laser beam is converted into a radially polarized beam using a zero-order vortex half-wave plate and subsequently introduced into a modified Twyman–Green interferometer. By slightly varying the illumination wavelength, two interferograms are recorded using a CMOS camera, and the corresponding phase variation is retrieved for surface-height reconstruction. The proposed method is experimentally demonstrated using a standard step gauge with illumination wavelengths of 632.8 and 632.82 nm. The measured step-height differences are 3.01, 0.88, 0.27, and 0.09 mm, with a maximum absolute error of 0.12 mm. The estimated height uncertainty is approximately 61.42 μm . The proposed method provides full-field, noncontact, and rapid surface measurement with an extended unambiguous measurement range.

Time 時間: 13:18–13:36, 10/15/2026

Location 地點: Lo Chia-Lun Lecture Hall 羅家倫講堂

Paper ID 論文編號: 1027

Large-Area Wafer Surface Topography Measurement Based on Shadow Moiré and Spatial Averaging

Yan-Cheng Hu^{1*}, Wei Chen¹, Ting-Hao Cao¹, Ju-Yi Lee¹

¹Department of Mechanical Engineering, National Central University

*Corresponding Author: HELLOBOY3314@gmail.com

This study develops a full-field surface-topography measurement method for 12-inch unpolished silicon wafers by combining shadow moiré with rotational spatial averaging. A white-light LED, a 40 μm linear grating, and a camera acquire one moiré image at each wafer orientation. FFT-based carrier extraction, phase demodulation, phase unwrapping, and phase-to-height conversion reconstruct the three-dimensional topography. Because the 14 $\times$ 14-inch glass grating sags under gravity, the raw measurement contains a fixed grating-deformation component. Spatial averaging estimates this fixed component while attenuating rotating wafer features. With 36 or more images, the compensated topography achieves Pearson correlation coefficients above 0.8 with commercial measurements, and the maximum warpage deviation over 72 angular positions is below 1.5 μm .

Time 時間: 13:36–13:54, 10/15/2026

Location 地點: Lo Chia-Lun Lecture Hall 羅家倫講堂

Paper ID 論文編號: 1036

Measurement Performance of Reflector-Aided LiDAR Localization for a High-Payload Autonomous Mobile Robot

Chen-Fei Yang¹, Yi-Chuan Tseng¹, Po Ting Lin^{1*}

¹Department of Mechanical Engineering, National Taiwan University of Science and Technology

*Corresponding Author: potinglin@mail.ntust.edu.tw

Reliable localization is required when autonomous mobile robots are used as platforms for inspection or manipulation. This study evaluates a reflector-aided 2-D LiDAR localization method for a high-payload autonomous mobile robot, with emphasis on measurement accuracy and repeatability. Retroreflective landmarks are detected from LiDAR intensity data and associated with known reference coordinates. With three or more reflectors, the vehicle pose is estimated by SVD-based rigid-body registration, while a two-reflector tracking mode maintains localization continuity. Experiments at three fixed vehicle poses compared conditions with two to five visible reflectors. Position RMSE ranged from 17.9 to 31.1 mm, angular RMSE remained below 0.6° , and positional repeatability ranged from 0.62 to 2.30 mm. Increasing the number of observed reflectors consistently improved repeatability but did not monotonically reduce position error. The substantially smaller repeatability error than the absolute position RMSE suggests that random localization scatter is limited, whereas the remaining discrepancy is likely associated with systematic effects in the landmark coordinates and system calibration. The absolute-error assessment is also subject to the accuracy of the external reference measurement.

Time 時間: 13:54–14:12, 10/15/2026

Location 地點: Lo Chia-Lun Lecture Hall 羅家倫講堂

Paper ID 論文編號: 1049

Application of a Fizeau Interferometer Based on Electro-Optic Modulation and Error-Suppressed Phase Demodulation for Wafer Surface Topography Measurement

Jia-Ying Li¹, Yu-Yi Hsieh¹, Hung-Lin Hsieh^{1*}

¹Department of Mechanical Engineering, National Taiwan University of Science and Technology

*Corresponding Author: hlhsieh@mail.ntust.edu.tw

This study employs an electro-optic modulator (EOM) as an alternative to wavelength modulation, enabling the implementation of the $10N-9$ phase-demodulation algorithm for Fizeau interferometric measurement of wafer surface topography. Compared with Surrel's $2N-1$ algorithm, the peak-to-valley (PV) and root-mean-square (RMS) values obtained using the $10N-9$ algorithm were reduced by 67.9% and 42.1%, respectively. In the repeatability tests, the lowest coefficient of variation, 4.65%, was obtained at $N=10$. In the $10\text{ }\mu\text{m}$ push-displacement experiment, the PV value of the differential surface was $10.555\text{ }\mu\text{m}$. Angular displacement and stability tests further verified the measurement capability of the system. The results demonstrate that the EOM provides a feasible alternative to a wavelength-modulation-based configuration.

Time 時間: 14:12–14:30, 10/15/2026

Location 地點: Lo Chia-Lun Lecture Hall 羅家倫講堂

Paper ID 論文編號: 1073

Polarization-Multiplexed Single-Shot Dual-Wavelength Lens-Free Holographic Imaging

Chung-Hsuan Huang¹, Chau-Jern Cheng², Han-Yen Tu^{1*}

¹Department of Electrical Engineering, Chinese Culture University

²Institute of Electro-Optical Engineering, National Taiwan Normal University

*Corresponding Author: dhy@ulive.pccu.edu.tw

A single-shot dual-wavelength lens-free holographic imaging method based on polarization multiplexing is proposed for quantitative phase reconstruction. Two coherent beams with orthogonal linear polarization states are combined to illuminate the sample, and a polarization camera records both wavelength channels simultaneously. After polarization demultiplexing and spatial registration, two wavelength-resolved holograms are obtained from a single frame. An iterative dual-wavelength phase retrieval algorithm is then applied to suppress twin-image artifacts and recover the object phase. The proposed approach eliminates the need for wavelength switching, mechanical scanning, and temporal phase modulation while retaining the compact configuration and large field of view of lens-free holography. Experimental results demonstrate effective twin-image suppression and reliable phase reconstruction, indicating its potential for wide-field, noncontact optical inspection.

Time 時間: 14:30–14:48, 10/15/2026

Location 地點: Lo Chia-Lun Lecture Hall 羅家倫講堂

Paper ID 論文編號: 1099

In-Plane Displacement Measurement Using a Reflective Grating Interferometer

Kun-Huai Shen¹, Chun-Pin Chen¹, Hung-Lin Hsieh^{1*}

¹Department of Mechanical Engineering, National Taiwan University of Science and Technology

*Corresponding Author: hlhsieh@mail.ntust.edu.tw

Precision displacement measurement is widely applied in semiconductor manufacturing, precision positioning, and nanoscale metrology. Grating interferometers offer the advantages of non-contact measurement, high resolution, and reduced sensitivity to environmental refractive-index variations. This study develops a reflective grating interferometer that combines double diffraction with differential phase processing for in-plane displacement measurement. Experimental results show that the proposed system can track periodic displacements at scales of 10 μm , 1 μm , and 100 nm, as well as random displacements. The achieved in-plane displacement resolution is 2.55 nm. These results demonstrate the feasibility of the developed interferometer for precision in-plane displacement measurement and its potential for precision positioning and motion control.

E-SS2: AI and NDE 4.0, 人工智慧與非破壞評估 4.0

Session Chair: Po Ting Lin

主持人: 林柏廷

Time 時間 : 13:00-14:12, 10/15/2026

Location 地點 : Glass Classroom 玻璃屋

Time 時間	Paper ID 論文編號	Title 演講題目	Authors 作者
13:00- 13:18	1017	Experimental Assessment and LS-DYNA Validation of Auto-injector Drop-Impact Response	Hariyanto Gunawan, Hsing-Yu Chen, Pei-Chun Chen, AM Mufarrih
13:18- 13:36	1040	Vision-Language-Assisted Open-Vocabulary Recognition and 3D Measurement for Robotic Inspection	Lin-Shang Pan, Chii Hong Liu, Po Ting Lin
13:36- 13:54	1041	AI-Accelerated Virtual Dynamic Stability Assessment of Palletized Loads Using a Graph Network Surrogate Model	Jiong-Wei Lin, Ching-Fa Wu, Po Ting Lin, Chyi-Yeu Lin
13:54- 14:12	1112	IMU-Assisted Optical Flow Video Stabilization for Enhanced AI-DIC Drone for SHM of Large Structures	Jayanth Gowda B V, Sneha Prasad, Paaesee Rai, Rohan Kishor Nakade, David Kumar, Chih-Hung Chiang

Time 時間: 13:00-13:18, 10/15/2026

Location 地點: Glass Classroom 玻璃屋

Paper ID 論文編號: 1017

Experimental Assessment and LS-DYNA Validation of Auto-Injector Drop-Impact Response

Hariyanto Gunawan^{1*}, Hsing-Yu Chen¹, Pei-Chun Chen¹, AM Mufarrih¹

¹Department of Mechanical Engineering, Chung Yuan Christian University

*Corresponding Author: harrywey@cycu.edu.tw

Accidental drops can generate transient mechanical loads that may affect the structural integrity and operational reliability of auto-injectors. This study presents an instrumented impact assessment approach combining force sensing, high-speed imaging, and LS-DYNA simulation to characterize orientation-dependent drop responses. Four representative orientations—horizontal (0°) and Rear Cap Down at 30°, 60°, and 90°—were investigated through 30 repeated drop tests per condition at an impact velocity of 4.42 m/s, corresponding to a 1 m free fall. Transient impact forces were measured using a load-cell-based acquisition system, while high-speed imaging was used to verify the actual impact orientation. The experimental peak force increased from 70.427 N at Rear Cap Down 30° to 187.423 N at 90°, while the horizontal condition produced the highest value of 213.645 N. LS-DYNA predictions agreed well with the experimental results, with errors ranging from 1.38% to 9.93% and a mean absolute percentage error of approximately 4.3%. The results demonstrate the feasibility of integrating instrumented impact measurement, high-speed imaging, and numerical simulation for quantitative assessment of auto-injector impact response.

Time 時間: 13:18–13:36, 10/15/2026

Location 地點: Glass Classroom 玻璃屋

Paper ID 論文編號: 1040

Vision-Language-Assisted Open-Vocabulary Recognition and 3D Measurement for Robotic Inspection

Lin-Shang Pan¹, Chii Hong Liu¹, Po Ting Lin^{1*}

¹Department of Mechanical Engineering, National Taiwan University of Science and Technology

*Corresponding Author: potinglin@mail.ntust.edu.tw

This study presented a vision-language-assisted method for visual recognition and 3D measurement in robotic inspection. YOLO-World was used as the primary open-vocabulary detector, while a VLM complemented the system for ambiguous or semantically defined targets. Combined with RGB-D sensing and ChArUco-based calibration, the detected image coordinates were transformed into three-dimensional world coordinates. The mean RMS positioning error was 4.583 mm, which is on the

same order as the nominal depth accuracy of the RGB-D camera, indicating applicability to general robotic localization while further improvement is required for precision metrology. A representative end-to-end VLM call required approximately 21.03 s in the current implementation; therefore, the VLM was selectively used as a fallback mechanism rather than as a continuously executed detector. Future work will focus on reducing VLM latency, improving spatial accuracy, and validating the system using industrial metallic components with complex geometry and reflective surfaces under realistic NDT conditions.

Time 時間: 13:36–13:54, 10/15/2026

Location 地點: Glass Classroom 玻璃屋

Paper ID 論文編號: 1041

AI-Accelerated Virtual Dynamic Stability Assessment of Palletized Loads Using a Graph Network Surrogate Model

Jiong-Wei Lin¹, Ching-Fa Wu¹, Po Ting Lin^{1*}, Chyi-Yeu Lin¹

¹Department of Mechanical Engineering, National Taiwan University of Science and Technology

*Corresponding Author: potinglin@mail.ntust.edu.tw

Dynamic stability assessment of palletized loads is important for preventing sliding, tilting, and collapse during transportation. High-fidelity physics simulation can evaluate these behaviors without destructive physical testing, but its computational cost limits repeated or online assessment. This study develops an AI-accelerated virtual stability assessment method using a Graph Network-based Simulator (GNS) as a surrogate for MuJoCo rigid-body simulation. Palletized cartons are represented as graph nodes, while support and adjacency relationships are represented as edges. MuJoCo simulations under lateral dynamic excitation generate three-dimensional displacement and quaternion-based rotational responses for training the surrogate model. A dataset of 25,000 simulated stacking configurations was generated, with 20,000 samples used for training and 5,000 for validation. The trained GNS achieved median absolute errors of 3.3 mm in displacement and 0.36° in rotation, while 76.96% and 81.70% of predictions remained within 20 mm and 5°, respectively. The average

GNS inference time was 5.884 ms. These results demonstrate the feasibility of graph-network surrogate modeling for rapid virtual screening of palletized-load stability before high-fidelity simulation or physical testing.

Time 時間: 13:54–14:12, 10/15/2026

Location 地點: Glass Classroom 玻璃屋

Paper ID 論文編號: 1112

IMU-Assisted Optical Flow Video Stabilization for Enhanced AI-DIC Drone for SHM of Large Structures

Jayanth Gowda B V^{1*}, Sneha Prasad², Paaesee Rai¹,
Rohan Kishor Nakade³, David Kumar^{1*}, Chih-Hung Chiang⁴

¹Department of Aerospace Engineering, Indian Institute of Technology Madras

²Department of Computer Science and Engineering, Indian Institute of Information
Technology Vadodara

³SpaceKaur Autonomous Technologies, IITM Research Park

⁴Department of Civil and Construction Engineering, Chaoyang University of
Technology

*Corresponding Author: david@iitm.ac.in

UAV-based digital image correlation techniques have been extensively studied for assessing the structural health of large and hard-to-reach structures such as wind turbines, bridges, and buildings. However, these methods encounter challenges such as rotor-induced vibrations, wind-driven swaying, and difficulties in distinguishing between drone motion and structural deformation. To overcome these issues, this paper introduces an IMU-assisted optical flow video stabilization technique specifically designed to mitigate camera vibrations caused by drones. This approach leverages an AI-DIC drone system and enhances the existing self-vibration compensation algorithm. The Inertial Measurement Unit (IMU) estimates and compensates for the predominant rotational motion induced by the UAV, while Kanade-Lucas-Tomasi (KLT) based feature tracking is applied to the frames that experienced relatively less vibration during data collection. Further, the resulting motion data is filtered using an Extended Kalman Filter to produce stabilized frames. This developed IMU-assisted

optical flow video stabilization technique has been implemented on the AI-DIC drone system to generate a 3D damage profile of the damage present on the wall.

E-SS4: Advanced Electromagnetic Testing, 先進 電磁測試

Session Chair: Yu-Ching Lee

主持人: 李雨青

Time 時間 : 13:00-14:48, 10/16/2026

Location 地點 : Lo Chia-Lun Lecture Hall 羅家倫講堂

Time 時間	Paper ID 論文編號	Title 演講題目	Authors 作者
13:00- 13:27	1091 Invited Talk	Wave characteristics of magneto- electro-elastic laminates with imperfect interfaces	Yun-Hsuan Wang, Kuang-Hung Wei, Hsin-Yi Kuo
13:27- 13:54	1110 Invited Talk	Stress Position Detection Using Magnetoelastic Stray Magnetic Fields for Early Diagnosis of Industrial Structures	Gye Jo Jung
13:54- 14:12	1024	Low-frequency stretching force measurement of framed membranes	Yu-Ching Lee, Chun-Jui Hsu
14:12- 14:30	1035	Development and Application of Horizontally Polarized Guided Wave Electromagnetic Acoustic Transducer	Wen-Chuan Wu, Dun-Ning Zhang, Ching-Chung Yin
14:30- 14:48	1075	Guided-Wave Electromagnetic Acoustic Transducers: A Comprehensive Review	Ching-Chung Yin, Wen-Chuan Wu

Time 時間: 13:00-13:27, 10/16/2026

Location 地點: Lo Chia-Lun Lecture Hall 羅家倫講堂

Paper ID 論文編號: 1091 (Invited Talk)

Wave Characteristics of Magneto-Electro- Elastic Laminates with Imperfect Interfaces

Yun-Hsuan Wang¹, Kuang-Hung Wei¹, Hsin-Yi Kuo^{1*}

¹Department of Civil Engineering, National Yang Ming Chiao Tung University

*Corresponding Author: hykuo@nycu.edu.tw

We investigate the wave characteristics of the magneto-electro-elastic (MEE) laminated plates with interface imperfections. The MEE multilayer is assumed as a simply supported rectangular plate subjected to the appropriate boundary conditions. Both the generalized linear spring-type and generalized membrane-type imperfect interfaces are considered. We employ the pseudo-Stroh formalism and the propagator matrix method to establish the analytical solutions for an orthotropic MEE laminate. The derived solutions are then applied to BaTiO₃-CoFe₂O₄ sandwich plates. Numerical calculations show that the interface imperfection would be possible to tune wave features for the given layup.

Time 時間: 13:27–13:54, 10/16/2026

Location 地點: Lo Chia-Lun Lecture Hall 羅家倫講堂

Paper ID 論文編號: 1110 (Invited Talk)

Stress Position Detection Using Magnetoelastic Stray Magnetic Fields for Early Diagnosis of Industrial Structures

Gye Jo Jung^{1*}

¹SPDTech

*Corresponding Author: keprica63@naver.com

Large industrial assets contain extensive welds and highly loaded ferromagnetic regions, making full-area examination by detailed nondestructive testing (NDT) time- and resource-intensive. Stress Position Detection (SPD) is a passive magnetic pre-screening approach implemented within the Metal Magnetic Memory (MMM) framework. It measures spatial variations in the magnetic stray field without intentional magnetization and localizes abnormal regions, termed Stress Positions, for subsequent examination. This paper describes the measurement concept and summarizes field evidence from power-generation components and a welded tubular transmission tower. The accumulated power-generation work comprised 14,920 measurement points and a reported inspection length of 21,871,733 mm across four generating units. Five representative SPD-selected locations

were subsequently examined by phased-array ultrasonic testing (PAUT), ultrasonic testing (UT), post-cut examination, or replica metallography. The follow-up results included an internal slag inclusion in a header stub-tube weld, lack of fusion in a high-pressure pipe weld, incomplete penetration in a tubular transmission-tower weld, internal fatigue-related micro-cracking in a low-temperature reheater weld, and sulfide corrosion on a boiler water-wall tube. These cases demonstrate a consistent localization and prioritization function across different degradation conditions and verification methods. They do not establish standalone defect classification, sizing accuracy, or probability of detection. SPD is therefore positioned as a screening layer that directs conventional NDT to priority locations and supports condition-based inspection planning. Further prospective studies with predefined acceptance criteria and representative samples are required to quantify performance for each application.

Time 時間: 13:54–14:12, 10/16/2026

Location 地點: Lo Chia-Lun Lecture Hall 羅家倫講堂

Paper ID 論文編號: 1024

Low-Frequency Stretching Force Measurement of Framed Membranes

Yu-Ching Lee^{1*}, Chun-Jui Hsu¹

¹Department of Mechanical Engineering, National Taiwan University of Science and Technology

*Corresponding Author: yclee@mail.ntust.edu.tw

A new analytical technique for evaluating the stretching forces of a framed membrane from a dynamic vertical displacement measurement is presented. Two-dimensional wave equations relating the resonant frequencies to the stretching forces are derived. In this experiment, the technique utilizes membrane vibration from a shaker excitation to determine the resonant frequencies. In addition, different trial-and-error stretching forces values are substituted into the theoretical model to calculate the different resonant frequencies for matching the experimental values. Measurements are conducted at two positions on a commercial framed membrane, and the resulting FFT spectra are used to identify the (1,1) and (2,1) modes. The analytical calibration curves and the procedure for estimating

membrane tension from the measured modal frequencies are presented. The dependence of the two modes on stretching force and their relative frequency sensitivities are also discussed.

Time 時間: 14:12–14:30, 10/16/2026

Location 地點: Lo Chia-Lun Lecture Hall 羅家倫講堂

Paper ID 論文編號: 1035

Development and Application of Horizontally Polarized Guided Wave Electromagnetic Acoustic Transducer

Wen-Chuan Wu^{1*}, Dun-Ning Zhang², Ching-Chung Yin²

¹Department of Power Vehicle and Systems Engineering, Chung Cheng Institute of Technology, National Defense University

²Department of Mechanical Engineering, National Yang Ming Chiao Tung University

*Corresponding Author: wenchuan1031@gmail.com

Heat exchanger tubes are subject to harsh operational conditions, such as high temperatures and high pressures, making them prone to structural defects including wall thinning and cracking. Therefore, fast and long-range non-destructive testing (NDT) is essential. Guided wave testing offers key advantages of long inspection range and rapid screening, and has been widely used in pipeline inspection in recent years. In this study, an electromagnetic acoustic transducer (EMAT) was developed using periodic permanent magnet (PPM) arrays and screen-printed flexible circuits. Experimental results show that the custom PPM-EMAT successfully excites 200 kHz torsional guided waves in titanium bare tubes, reaching a propagation distance of up to 21 meters and effectively identifying a 5 mm circumferential through-hole defect. In periodic finned tubes, severe wave attenuation and structural bandgaps occur due to periodic fin resonance, preventing guided waves from penetrating into the finned region and causing reflections strictly within the bare pipe section. By adopting 128 kHz torsional guided waves for finned tube inspection, the measured group velocity is 1,785 m/s, with a wave attenuation rate of 3.5 dB/m and a maximum propagation distance of 5.9 meters. This study provides a systematic design methodology and experimental foundation for EMAT inspection of finned tubes.

Time 時間: 14:30–14:48, 10/16/2026

Location 地點: Lo Chia-Lun Lecture Hall 羅家倫講堂

Paper ID 論文編號: 1075

Guided-Wave Electromagnetic Acoustic Transducers: A Comprehensive Review

Ching-Chung Yin^{1*}, Wen-Chuan Wu²

¹Department of Mechanical Engineering, National Yang Ming Chiao Tung University

²Department of Power Vehicle and Systems Engineering, Chung Cheng Institute of Technology, National Defense University

*Corresponding Author: ccyin@nycu.edu.tw

Electromagnetic Acoustic Transducers (EMATs) have drawn significant research interest within non-destructive evaluation (NDE) owing to their non-contact operation, couplant-free mechanism, and simple structural configuration. In real-world industrial environments, surface contaminants such as heavy rust, oil films, scale, and surface roughness frequently distort ultrasonic signals and cause severe wave attenuation, posing significant challenges for conventional contact-based transducers. EMATs effectively mitigate these limitations by inducing Lorentz forces or magnetostrictive interactions to generate acoustic waves directly within the conductive material. Although their broader commercial deployment remains constrained by inherently low electromagnetic-acoustic transduction efficiency and lower signal-to-noise ratios (SNR), recent innovations in high-field permanent magnet arrays, optimized coil geometries, and novel signal-processing algorithms have substantially narrowed this performance gap. This work provides a comprehensive review of state-of-the-art guided-wave EMAT technologies, detailing fundamental transduction physics, performance enhancement strategies, and emerging high-temperature and automated inspection applications.

C-SS1: Advanced Optical Metrology, 先進光學 量測技術

Session Chair: Kun-Huang Chen

主持人: 陳坤煌

Time 時間: 15:12-17:00, 10/15/2026

Location 地點: Lo Chia-Lun Lecture Hall 羅家倫講堂

Time 時間	Paper ID 論文編號	Title 演講題目	Authors 作者
15:12-15:30	1005	多光源的電鍍工件刮痕檢測系統開發	周品好, 李維楨
15:30-15:48	1008	應用於奈米粒子追蹤分析之FPGA 雙尺度高斯差分即時前處理架構	周彥廷, 何昭慶, 蘇詠靖
15:48-16:06	1016	基於YOLOv11之碳纖維表面多缺陷影像辨識研究	張家源, 劉建宏
16:06-16:24	1093	超穎表面結構之全光繞射神經網路應用於高速影像辨識技術研究	楊曼岑, 沈志雄
16:24-16:42	1107	反光金屬零件之雙視角輪廓精修六自由度姿態估測	范潤洋, 林錦德
16:42-17:00	1109	感測頭熱穩定性對紅外高溫計測溫精準度之影響	康皓宇, 邱政斌, 陳玉彬

Time 時間: 15:12-15:30, 10/15/2026

Location 地點: Lo Chia-Lun Lecture Hall 羅家倫講堂

Paper ID 論文編號: 1005

多光源的電鍍工件刮痕檢測系統開發

周品好¹, 李維楨^{1*}

¹ 國立臺灣科技大學機械系

*Corresponding Author: wlee@mail.ntust.edu.tw

本研究首先設計並建置了一套具備三種光源入射角度、八個光源方位及三種光源顏色的可調特性環形光源燈具，用來優化照明條件，以有效凸顯高反光表面上的刮痕。實驗結果顯示，在多種光源組合中，45 度入射角且照射方向與刮痕走向垂直的藍色光源，能顯著提升刮痕的可見度。在影像處理方面，本研究開發了一套演算法流程，包含高斯濾波、Gabor 濾波、自適應二值化、開運算及連通域分析等技術，用於分析刮痕特徵，並使用相同規格的電鍍工件進行驗證。結果表明，在 45 度入射角的藍色對向光源下，使用交聯集比例(Intersection over Union, IoU)閾值為 0.8 的嚴格標準進行測試，演算法在偵測嚴重且明顯的刮痕上可達 83.3%的精密度(precision)。

Time 時間: 15:30-15:48, 10/15/2026

Location 地點: Lo Chia-Lun Lecture Hall 羅家倫講堂

Paper ID 論文編號: 1008

應用於奈米粒子追蹤分析之 FPGA 雙尺度高斯差分即時前處理架構

周彥廷¹, 何昭慶^{2*}, 蘇詠靖²

¹ 國立臺北科技大學半導體科技碩士學位學程

² 國立臺北科技大學製造科技研究所

*Corresponding Author: hochao@mail.ntut.edu.tw

奈米粒子追蹤分析 (NTA) 之即時應用需兼顧影像處理品質與運算吞吐率，既有軟體或通用處理器架構難以滿足高解析度串流即時處理需求。本研究提出 FPGA 雙尺度高斯差分 (DoG) 串流架構，以多次疊代 box filter 近似高斯卷積，搭配定點量化與雙通道延遲對齊，抑制暗場散射影像非均勻背景並強化粒子特徵。架構於 AMD Zynq UltraScale+ ZCU106 平台實現，時脈 250 MHz。實驗結果顯示，FPGA 輸出與位元精確軟體參考模型完全一致 (MSE 為 0、PSNR 為 ∞)，驗證硬體邏輯正確性；整合至完整 NTA 流程後，PS 200 nm 標準粒子之粒徑眾數為 202 nm；LUT、FF、DSP 占用率均低於 1%，BRAM 約 23%；實測單張 1224×1024

影像處理時間為 5.1 ms，較 CPU 快約 17.3 倍，功耗僅 0.76 W（CPU 為 125 W），顯示本架構兼具高吞吐率、低資源與低功耗優勢，適合即時奈米粒子監測應用。

Time 時間: 15:48–16:06, 10/15/2026

Location 地點: Lo Chia-Lun Lecture Hall 羅家倫講堂

Paper ID 論文編號: 1016

基於 YOLOv11 之碳纖維表面多缺陷影像辨識研究

張家源^{1*}, 劉建宏¹

¹ 國立中興大學循環經濟研究學院

*Corresponding Author: william558821@gmail.com

在複合材料自動化製程中，非破壞式即時缺陷監測為提升產品品質與製程穩定性之關鍵。自動纖維鋪放製程（Automated Fibre Placement, AFP）中，碳纖維複合材料因具高反射性與明顯表面紋理，使表面缺陷特徵不易辨識，易造成傳統視覺檢測之誤判與漏判。本研究以 YOLOv11 為基礎建立影像式非破壞缺陷偵測模型，透過非接觸影像擷取方式，偵測碳纖維表面多類型缺陷，包括間隙、氣泡、皺褶與異物。並導入資料增強方式提升影像多樣性，以改善模型對不同光照、表面紋理與細微缺陷之辨識能力。研究結果可作為後續智慧化複合材料非破壞品質檢測系統之基礎。

Time 時間: 16:06–16:24, 10/15/2026

Location 地點: Lo Chia-Lun Lecture Hall 羅家倫講堂

Paper ID 論文編號: 1093

超穎表面結構之全光繞射神經網路應用於高速 影像辨識技術研究

楊曼岑^{1*}, 沈志雄¹

¹國立彰化師範大學機電工程學系

*Corresponding Author: s1251006@gm.ncue.edu.tw

本研究建立結合嚴格耦合波分析法 (Rigorous Coupled-Wave Analysis, RCWA) 與 Metasurface 單元設計之全光繞射式深度神經網路 (Diffractive Deep Neural Network, D2NN) 模擬架構, 以探討理想數值相位轉換為實際奈米結構後之光學分類性能。首先利用 RCWA 分析 TiO₂ nanopillar 之相位與透射特性, 並建立 Phase–Geometry–Transmission Lookup Table (LUT); 再將三層 D2NN 訓練所得之連續相位進行離散化, 進一步映射至具有實際幾何尺寸、相位響應與透射特性之 Metasurface 單元。最後比較 Continuous D2NN、Ideal 8-Level D2NN 與 RCWA Metasurface D2NN 之光學分類表現。模擬結果顯示, 相位量化及實際 Meta-atom 光學響應會改變輸出光場於偵測區域之能量分布, 但三種模型於目前測試資料中仍呈現相近的分類結果。此結果顯示, 將 D2NN 理想相位映射至實際 Metasurface 單元具有初步可行性, 可作為後續元件設計與實體化研究之基礎。

Time 時間: 16:24–16:42, 10/15/2026

Location 地點: Lo Chia-Lun Lecture Hall 羅家倫講堂

Paper ID 論文編號: 1107

反光金屬零件之雙視角輪廓精修六自由度姿態 估測

范潤洋^{1*}, 林錦德¹

¹ 國立中央大學機械系

*Corresponding Author: yang40724220@gmail.com

自動化取放作業中，機械手臂須先取得零件之六自由度姿態，然而金屬零件之鏡面反射常使深度感測器量得的深度缺失或錯誤，使依賴深度之姿態估測方法產生傾斜誤差。因此本研究提出免訓練之雙視角輪廓精修方法，先以 MegaPose 由 CAD 模型取得初始姿態，再利用兩台相機拍攝之物件輪廓，透過可微分渲染最佳化姿態，使渲染輪廓與觀測遮罩貼合，不依賴深度資訊即可修正單一視角難以觀察之傾角。於 ROBI 資料集七種金屬件上測試，本方法之平均正確率達 59.8%，高於 MegaPose 官方 RGB-D 模型之 36.4% 與 IndusPose 模型之 47.3%。在實體場域中，估測姿態可即時同步顯示於 Isaac Sim 之虛擬場景。

Time 時間: 16:42-17:00, 10/15/2026

Location 地點: Lo Chia-Lun Lecture Hall 羅家倫講堂

Paper ID 論文編號: 1109

感測頭熱穩定性對紅外高溫計測溫精準度之影響

康皓宇^{1*}, 邱政斌², 陳玉彬¹

¹ 國立清華大學動力機械工程學系

² 技鼎股份有限公司

*Corresponding Author: kangkang821120@gmail.com

高溫計具備非接觸與快速響應等優點，但長時間鄰近高溫輻射源時，感測頭受熱可能造成額外的測溫偏差。本研究以黑體爐作為高溫待測目標，探討感測頭熱穩定性對紅外高溫計測溫精準度之影響，並分別採用間歇自然冷卻與主動水冷控制感測頭溫度。結果顯示，主動水冷可降低各測溫點之偏差，且最低降至 0.17°C。本研究說明感測頭熱穩定性為影響高溫非接觸測溫性能的重要因素，而持續熱管理則有助於維持量測精準度與穩定性。

C-SS2: AI and NDE 4.0, 人工智慧與非破壞評估 4.0

Session Chair: Po Ting Lin

主持人: 林柏廷

Time 時間：13:00-14:48, 10/16/2026

Location 地點：Multi-Functional Classroom 多功能教室

Time 時間	Paper ID 論文編號	Title 演講題目	Authors 作者
13:00-13:18	1048	基於正例－未標記學習與極端隨機樹集成多波束聲納目標濾波之魚群監測研究	梁育翔, 盧光輝, 李明安, 溫博浚
13:18-13:36	1050	人工智慧於積層製造非均勻材料性質之預測	黃宇綻, 楊哲化, 蔡官邑
13:36-13:54	1051	利用神經算子物理一致性及蘭姆波頻散於機械性質之反算	蘇彥宇, 楊哲化, 李育緯
13:54-14:12	1054	結合人工智慧材料常數識別之無人機複合材料結構老化評估與壽命預測	劉警文, 金大仁
14:12-14:30	1063	以時序列印參數與流變性質之深度學習預測生物支架線徑研究	蘇暉凱, 曾偉智, 楊程軒, 廖昭仰
14:30-14:48	1092	石化產業鋸道射線檢測影像之人工智慧輔助缺陷辨識	林榮讚, 張啓瑞, 吳紹琪, 吳郁君

Time 時間：13:00-13:18, 10/16/2026

Location 地點：Multi-Functional Classroom 多功能教室

Paper ID 論文編號：1048

基於正例－未標記學習與極端隨機樹集成多波束聲納目標濾波之魚群監測研究

梁育翔^{1*}, 盧光輝², 李明安², 溫博浚¹

¹ 國立臺灣海洋大學機械與機電工程學系
² 國立臺灣海洋大學環境生物與漁業科學學系

*Corresponding Author: sean900810@gmail.com

多波束聲納可持續觀測養殖場域中的水下目標，但使用聲納分析軟體（Echoview）進行候選目標濾波時，通常需依魚種、場域與資料品質調整參數。本研究利用人工智慧（AI）演算法學習 Echoview 既有的目標篩選結果，並評估模型泛化至不同魚種與資料條件的能力，以降低反覆人工調整參數的需求。研究以濾波前候選目標（clean targets）為輸入，將屬性篩選後目標（threshold targets）與同一發射週期（ping）的候選目標進行一對一空間配對，形成可靠正例；其餘候選目標視為未標記資料，據此建立採用極端隨機樹集成（ExtraTrees）的正例－未標記學習濾波器。驗證採外層留一資料集法（Leave-One-Dataset-Out，LODO），每輪保留一組完整資料作為未知測試集，分類門檻僅由其餘訓練資料的內層驗證決定。資料內重建的預測目標軌跡數量完成度介於 92.8% 至 100.0%，平均為 97.7%；跨資料集測試中，以虱目魚（milkfish）的預測軌跡數最接近參考區域數，數量比例為 81.8%。

Time 時間: 13:18-13:36, 10/16/2026

Location 地點: Multi-Functional Classroom 多功能教室

Paper ID 論文編號: 1050

人工智慧於積層製造非均勻材料性質之預測

黃宇綻^{1*}, 楊哲化¹, 蔡官邑¹

¹ 國立臺北科技大學機械工程系機電整合研究所

*Corresponding Author: s61706abcd@gmail.com

積層製造工件受逐層堆疊與重複固化影響，材料性質可能沿厚度方向呈現非均勻分布。雷射超音波導波可由蘭姆波頻散關係反映材料參數，但傳統多參數反算易受計算成本、參數耦合與非唯一解影響。本研究利用單層板蘭姆波理論與遞迴近似勁度矩陣法建立理論頻散資料庫，並以 1D-CNN 比較單階段與兩階段預測策略。兩階段先預測平均彈性係數與厚度，再換算層

數並限縮資料庫以預測線性梯度係數。結果顯示，厚板層數誤差由 37.5%、40.0%降至 6.25%、7.50%，且頻散重建獲得改善。所得梯度係數應視為既定模型下之等效材料參數。

Time 時間: 13:36–13:54, 10/16/2026

Location 地點: Multi-Functional Classroom 多功能教室

Paper ID 論文編號: 1051

利用神經算子物理一致性及蘭姆波頻散於機械性質之反算

蘇彥宇^{1*}, 楊哲化¹, 李育緯¹

¹國立臺北科技大學製造科技研究所

*Corresponding Author: ok350507@gmail.com

傳統蘭姆波材料參數反算需比對實驗與理論頻散曲線，反覆調整材料參數，且需人工辨識模態，較為耗時。本研究結合卷積神經網路（CNN）與視覺轉換器（ViT）建立反算模型，由頻率一波數（ $f-k$ ）圖估測特徵波速、蒲松比與厚度；另以自適應傅立葉神經算子（AFNO）建立正算模型，將反算參數轉回頻散圖，與理論頻散圖比較，並在訓練時依兩者差異修正反算模型。在 12,000 組理論資料驗證中，原始與劣化影像的平均絕對百分比誤差（MAPE）為 0.763%與 0.963%。真實薄板及 13 組鋁合金圓管測試時，預測誤差較理論資料明顯增加，銅片厚度在不同應力下的平均差異達 75.23%。結果顯示本方法具反算可行性，但理論與實驗資料仍有明顯落差。

Time 時間: 13:54-14:12, 10/16/2026

Location 地點: Multi-Functional Classroom 多功能教室

Paper ID 論文編號: 1054

結合人工智慧材料常數識別之無人機複合材料 結構老化評估與壽命預測

劉警文^{1*}, 金大仁¹

¹ 國立陽明交通大學工學院碩士在職專班

*Corresponding Author: a72113009@gmail.com

隨著無人機技術快速發展，其應用已涵蓋物流、環境監測、農業巡檢及國防等領域。無人機結構多採用複合材料製成，其結構完整性直接影響飛行安全。為避免複合材料長期承受疲勞載荷造成性能劣化，本文提出一套結合人工智慧（Artificial Intelligence, AI）之結構健康監測與壽命預測方法。於無人機執行飛行任務期間進行結構監測與數據收集，並利用 AI 模型由量測之應變值識別材料常數，進而評估結構劣化程度與預測後續飛行任務之安全性。同時，以有限元素法建立 AI 模型訓練資料庫，使模型具備材料性能識別與結構失效預測能力。藉由所提出之方法，可於結構失效前提供預警，作為構件維修或更換之依據，提升無人機結構之可靠度與服役壽命。

Time 時間: 14:12-14:30, 10/16/2026

Location 地點: Multi-Functional Classroom 多功能教室

Paper ID 論文編號: 1063

以時序列印參數與流變性質之深度學習預測生 物支架線徑研究

蘇暉凱¹, 曾偉智², 楊程軒¹, 廖昭仰^{1*}

¹ 國立中央大學機械工程學系

²國立中山大學機械與機電工程學系

*Corresponding Author: cyliao@ncu.edu.tw

組織工程中，擠出式生物列印之支架線寬穩定性攸關孔隙結構與品質。因成型高度非線性且受製程參數與流變特性共同影響，本研究整合時序列印資料與殼聚醣流變性質，建立深度學習預測模型。透過 Herschel-Bulkley 模型擬合流變參數，並依針頭溫度對應時序，將列印參數與稠度、流動指數等 8 項特徵輸入 TCN-GRU 混合模型預測線寬。結果顯示，模型之預測準確率為 98.13%，可提供未來參數即時調控之參考。

Time 時間: 14:30-14:48, 10/16/2026

Location 地點: Multi-Functional Classroom 多功能教室

Paper ID 論文編號: 1092

石化產業鐳道射線檢測影像之 人工智慧輔助缺陷辨識

林榮讚¹, 張啓瑞¹, 吳紹琪¹, 吳郁君^{1*}

¹社團法人中華民國工業安全衛生協會高雄技術服務處

*Corresponding Author: ycwu@mail.isha.org.tw

本研究旨在改善石化鐳道射線檢測 (RT) 仰賴人工判片及判讀一致性不足等問題，建立 AI 缺陷初篩與人工複判架構。由 2^{1,2}92 張底片中篩選 229 張作為兩種模型架構之開發資料。兩種模型架構 (A、B) 皆採兩階段辨識，第一階段辨識鐳道位置、第二階段辨識缺陷，架構 A 採 YOLO11n 定位偵測模型+ResNet-18 殘差神經網路進行缺陷影像分類，準確率 (accuracy)、召回率 (recall) 與精確率 (precision) 為 0.960、0.940、1.000；架構 B 採 YOLO11n 定位模型+YOLO11n 物件偵測模型，以 206 張進行 5 折交叉驗證，另保留 23 張獨立測試集作為模型驗證，準確率 (accuracy)、召回率 (recall) 與精確率 (precision) 為 0.909、0.942、0.888。A 效能較高但可能受人工標記干擾；B 可定位疑似缺陷，較利複判。後續將以跨廠未標記影像進行同條件盲測，評估實務可行性。

C-SS3: Guided Wave NDT, 導波非破壞檢測

Session Chair: Ping Hung Lee

主持人: 李秉鴻

Time 時間：15:12-16:24, 10/16/2026

Location 地點：Future Classroom 未來教室

Time 時間	Paper ID 論文編號	Title 演講題目	Authors 作者
15:12-15:30	1101	導波監測系統於管線腐蝕預警之能力評估	李秉鴻, 余國禎, 朱民宏, 林建凱, 陳漢昕, 王俊傑, 李尚樺
15:30-15:48	1103	基於導波模態共振之快速測厚與腐蝕成像研究	李秉鴻, 蔡建安, 李志杰, 杜權家, 陳昕, 宋泓慶
15:48-16:06	1106	以高頻導波檢測不銹鋼管點蝕能力之研究	李秉鴻, 余國禎, 朱民宏, 林建凱, 陳漢昕
16:06-16:24	1111	基於機器學習之熱交換管渦電流檢測缺陷辨識系統開發	吳維勁, 古運承, 廖駿偉

Time 時間：15:12-15:30, 10/16/2026

Location 地點：Future Classroom 未來教室

Paper ID 論文編號：1101

導波監測系統於管線腐蝕預警之能力評估

李秉鴻^{1*}, 余國禎¹, 朱民宏¹, 林建凱¹, 陳漢昕¹, 王俊傑², 李尚樺²

¹ 凱德威有限公司

² 台灣中油公司石化事業部設檢課

*Corresponding Author: lechung1218@gmail.com

管線腐蝕管理正面臨從定期抽檢轉型為全天候健康監測(SHM)的關鍵時刻。本文探討永久安裝式導波監測系統(gPIMS)結合溫度補償(LSTC)與高頻感測技術之實務效益。研究於 8 吋碳鋼管進行步進式加工 (1.8%至 5.6% CSC)與 60 天稀硫酸連續腐蝕實驗，證實系統具高靈敏預警能力。進一步結合國際實績，包含碼頭管線隱蔽腐蝕檢出、埋地管線油泥監測，以及盲測

中超越傳統單次檢測 5 倍之靈敏度。gPIMS 不僅消除人為誤差與搭架成本，更提供精準腐蝕速率，為管線完整性管理提供極具商業價值之最佳解方。

Time 時間: 15:30–15:48, 10/16/2026

Location 地點: Future Classroom 未來教室

Paper ID 論文編號: 1103

基於導波模態共振之快速測厚與腐蝕成像研究

李秉鴻^{1*}, 蔡建安², 李志杰², 杜權家¹, 陳昕¹, 宋泓慶¹

¹凱德威有限公司

²JXB Technologies

*Corresponding Author: leehung1218@gmail.com

常壓儲槽壁板與壓力容器胴體板狀結構在常溫服役下，易因內容物與操作條件引發局部腐蝕與均勻減薄。在進行超音波測厚時，傳統壓電超音波點測需打磨除漆並塗布耦合劑，在檢測規劃時無法提高檢測覆蓋率以及檢測有效性。本文由凱德威公司（Guided Wave Ltd.）與 JXB 公司共同研發電磁快掃技術 ERMS，在頻域解析水平剪力波截止共振峰值以精準反算剩餘壁厚值。ERMS 技術的核心優勢在於完全免除漆、不需耦合劑，能直接穿透防腐塗層進行高速動態滾輪掃查；同時結合位移編碼器即時產出大面積高密度二維腐蝕成像圖，不僅徹底消除離散點測盲區與人為耦合誤差，更顯著節省檢測工時，實現精準壁厚量化評估。

Time 時間: 15:48–16:06, 10/16/2026

Location 地點: Future Classroom 未來教室

Paper ID 論文編號: 1106

以高頻導波檢測不銹鋼管點蝕能力之研究

李秉鴻^{1*}, 佘國禎¹, 朱民宏¹, 林建凱¹, 陳漢昕¹

¹凱德威有限公司

*Corresponding Author: leehung1218@gmail.com

傳統低頻 T(0,1) 模態導波主要用於碳鋼管線篩檢，其檢出門檻需截面積變化量（CSC）達 3% 以上。然而特化廠與 API 570/574 關注之不銹鋼管線，點蝕孔徑多為 1 mm 至 5 mm，易誘發應力腐蝕破裂（SCC）。近期 GUL 公司推出高解析度 HD 感測環，藉激發高頻短波長導波，使微小點蝕長距離快篩成為可能。本研究針對 2 至 8 吋不銹鋼管進行實驗與在役實測，驗證靈敏度門檻達 0.3%~0.5% CSC/ECL。結果表明，孔徑 3 mm 至 5 mm 之孤立點蝕可被明確檢出；孔徑小於 2 mm 者若呈群集點蝕亦能有效識別。現場 4 吋不銹鋼管實測成功捕捉 0.51%~0.65% 群集點蝕，證實高頻導波具備優異之點蝕普查能力，為特化廠管檢提供新選擇。

Time 時間: 16:06-16:24, 10/16/2026

Location 地點: Future Classroom 未來教室

Paper ID 論文編號: 1111

基於機器學習之熱交換管渦電流檢測缺陷辨識系統開發

吳維勁¹, 古運承¹, 廖駿偉^{1*}

¹長庚大學機械工程學系

*Corresponding Author: markliaw@mail.cgu.edu.tw

本研究開發基於機器學習之熱交換管渦電流缺陷辨識系統，以降低人工判讀對經驗的依賴。針對標準管與現場資料建立分層式訊號處理流程，結合基線校正、濾波及異常點定位，並比較三種缺陷辨識與深度估測模型。結果顯示，結合差分相位與幅值遮罩之全連接多任務模型表現最佳，可正確辨識 425 筆具深度標註樣本及 249 筆無深度標註樣本；深度估測之決定係數為 0.922，均方根誤差為 7.89%，平均絕對誤差為 6.22%。另建置圖形化介面整合資料處理與預測結果，提供可檢核的輔助判讀流程。研究成果具應用潛力，仍須透過跨管件與獨立現場資料驗證。

C-SS5: Advanced Vibration Testing, 先進振動測試

Session Chair: Chan-Yi Liao

主持人: 廖展誼

Time 時間: 15:12-16:42, 10/16/2026

Location 地點: Multi-Functional Classroom 多功能教室

Time 時間	Paper ID 論文編號	Title 演講題目	Authors 作者
15:12-15:30	1010	單一板型試片之壓電材料常數混合式反算方法	林育廷, 黃育熙
15:30-15:48	1012	鋼珠撞擊與壓電陶瓷激振下自由邊界圓板與短圓柱之振動特性量測	蘇于琪, 劉有晟, 翁珮旋
15:48-16:06	1029	曲率可控的動態光纖位移感測器	莊國志
16:06-16:24	1043	壓電機器人設計與性能實驗分析	林育志, 馮聖皓, 陳冠霖, 謝睿祺
16:24-16:42	1094	基於振動訊號與深度學習之 6061 鋁合金微孔加工品質非破壞評估	郭瀚聲, 何青原, 林冠廷

Time 時間: 15:12-15:30, 10/16/2026

Location 地點: Multi-Functional Classroom 多功能教室

Paper ID 論文編號: 1010

單一板型試片之壓電材料常數混合式反算方法

林育廷^{1*}, 黃育熙¹

¹ 國立臺灣大學機械系

*Corresponding Author: fl2522511@ntu.edu.tw

壓電材料常數易受製程與保存條件影響，而傳統 IEEE 共振法需使用多種不同尺寸與極化方向之試片，量測程序較為複雜。本研究提出結合 Mindlin 厚板理論、實驗量測與簡單基因演

算法之混合式材料常數反算方法。利用圓形與矩形全自由邊界壓電板之面內與面外共振頻率，搭配超音波、壓電應變常數及介電性質量測，降低低靈敏度參數造成之反算不確定性。已知常數驗證結果顯示，多數參數反算誤差約低於 3%；實際 PZT 試片之圓板與矩板反算結果亦具良好一致性。有限元素分析進一步顯示，反算常數可有效預測實驗共振頻率，證明本方法具壓電材料完整常數辨識之可行性。

Time 時間: 15:30–15:48, 10/16/2026

Location 地點: Multi-Functional Classroom 多功能教室

Paper ID 論文編號: 1012

鋼珠撞擊與壓電陶瓷激振下自由邊界圓板與短圓柱之振動特性量測

蘇于琪^{1*}, 劉有晟¹, 翁珮旋¹

¹ 國立成功大學土木工程學系

*Corresponding Author: yuchisu@mail.ncku.edu.tw

本文以實驗量測與有限元素模擬相互驗證，探討自由邊界下厚度 7.53 mm 與 15.02 mm 鋁圓板及高度 50.12 mm 鋁短圓柱之振動特性，激振方式分別採用鋼珠撞擊與壓電陶瓷分段掃頻。頻域中三個待測物在兩種激振下之共振頻率與模擬的誤差皆在 1.72 % 以內，且壓電薄膜的訊雜比優於應變規。研究發現壓電陶瓷搭配掃頻可將能量集中於目標頻段，響應峰值遠高於鋼珠撞擊，並能同時激發面外與面內模態。

Time 時間: 15:48–16:06, 10/16/2026

Location 地點: Multi-Functional Classroom 多功能教室

Paper ID 論文編號: 1029

曲率可控的動態光纖位移感測器

莊國志^{1*}

¹ 國立台灣大學機械工程學系

*Corresponding Author: chuangkc@ntu.edu.tw

當光纖受到彎曲，光纖內的導光會洩露而發生光損失。這個特性稱為巨彎損失。巨彎損失的特性可以用來測量物理量的變化。然而，光纖的曲率不容易控制，感測信號的線性度也就不容易控制。在本研究中，我們首先受到植物卷鬚捲繞機理的啟發，我們利用巨彎損失，開發了一種彈簧狀感測器。由於彈簧的低剛性特性，這種接觸式感測器的負載效應可以大幅降低。為了在利用巨彎損失的過程中同時簡化製程，我們提出一種可穩定成型且精確可控的巨彎損失的光纖位移感測器設計。我們所提出的光纖彈簧具有與機械彈簧一樣的良好彈性，因此可用於測量大位移。改良後的光纖感測器雖然犧牲了剛性，具有製程更加簡單，形貌更加可控的優勢。

Time 時間: 16:06–16:24, 10/16/2026

Location 地點: Multi-Functional Classroom 多功能教室

Paper ID 論文編號: 1043

壓電機器人設計與性能實驗分析

林育志^{1,2}, 馮聖皓², 陳冠霖², 謝睿祺^{2*}

¹ 國立臺灣科技大學機械系

² 國立臺灣海洋大學機械系

*Corresponding Author: eric770218@gmail.com

本研究設計一微型仿生機器人。此機器人使用壓電雙晶片作為致動器，身體則參考昆蟲之外形，且藉由足部形狀的設計，讓前後兩個方向的摩擦力不對稱，而能在高頻振動下產生位移。除了進行機器人速度實驗，我們並以 ANSYS 做模態與諧振響應分析，評估設計之可行性。完成實體組裝後，以 80 Vpp 的電壓進行 0 至 1000 Hz 的掃頻實驗，記錄各頻率下的速度。研究共設計了四種外型，其中 Case I 在 840 Hz 時達到最大前移速度 7.81 cm/s，為四個外型中速度最快者；Case III 的模態模擬頻率（558.37 Hz）與實驗峰值頻率（560 Hz）幾乎完全吻合，顯示數值模擬模型具有一定的預測參考價值。此外實驗也觀察到，改變機器人外型與操作頻率會使機器人出現後退現象，因此我們可藉由不同的頻率與機構設計操控機器人的行進方向。

Time 時間: 16:24-16:42, 10/16/2026

Location 地點: Multi-Functional Classroom 多功能教室

Paper ID 論文編號: 1094

基於振動訊號與深度學習之 6061 鋁合金微孔加工品質非破壞評估

郭瀚聲¹, 何青原^{1*}, 林冠廷¹

¹ 國立成功大學機械工程學系

*Corresponding Author: n16142024@gs.ncku.edu.tw

本研究提出一套以三軸振動訊號與長短期記憶網路（LSTM）為核心之非破壞式鑽削品質評估方法，以 6061 鋁合金微孔加工之孔壁表面粗糙度 Ra 為監測目標。首先以 30 組主軸轉速與進給率進行參數篩選，8300 rpm 與 200 mm/min 可獲得最低 Ra 0.026 μm 且刀具磨耗較輕。其後於長時間鑽削中擷取三軸振動訊號，結合 FFT、Poincaré Map 與 Hilbert 轉換特徵，建立 LSTM 回歸模型。結果顯示約 3500 孔後 Ra 波動及 4380 Hz 與其諧波振幅同步增加，顯示加工穩定性與刀具健康開始劣化；LSTM 對 1000 筆實測 Ra 之整體 MAPE 約 5.2%，可有效追蹤品質變化。本方法可在不中斷加工的情況下提供孔壁品質與刀具狀態之間接評估，具線上監測與預知維護應用潛力。

C-SS6: Inspection for Nuclear Power Plants, 核電廠檢測

Session Chair: Joe-Ming Chang

主持人: 張佐民

Time 時間: 15:12-17:00, 10/16/2026

Location 地點: Lo Chia-Lun Lecture Hall 羅家倫講堂

Time 時間	Paper ID 論文編號	Title 演講題目	Authors 作者
15:12-15:30	1053	核電廠除役過渡階段碳鋼管材腐蝕行為研究	呂文豐, 蔡坤釗
15:30-15:48	1057	模擬乾式貯存實驗後用過核子燃料護套完整性之非破壞檢驗	謝堯瀚
15:48-16:06	1064	美國 IPEC 之燃料池外牆滲漏案例研析	張佐民, 呂文豐
16:06-16:24	1069	美國 Palisades 核電廠重啟檢測之蒸汽產生器管路破損案例研析	張佐民, 呂文豐
16:24-16:42	1095	核電廠乾式貯存密封鋼筒銲接之非破壞檢測作業	李建洲
16:42-17:00	1108	以中子繞射方法研究銅質材料腐蝕行為	雍敦元, 呂文豐, 蔡坤釗, 李文献

Time 時間: 15:12-15:30, 10/16/2026

Location 地點: Lo Chia-Lun Lecture Hall 羅家倫講堂

Paper ID 論文編號: 1053

核電廠除役過渡階段碳鋼管材腐蝕行為研究

呂文豐^{1*}, 蔡坤釗¹

¹ 國家原子能科技研究院材料所

*Corresponding Author: wflu@nari.org.tw

本研究為利用 A106 B 管材進行模擬核電廠除役過渡階段靜滯水環境之腐蝕實驗，包含三組實驗：(一)實驗(1)模擬除役過渡階段完全沒有水流動的狀況，冷抽(C)與熱軋(H)試片腐蝕速率分別為 $23\mu\text{m}/\text{year}$ 與 $19\mu\text{m}/\text{year}$ ；(二)實驗(2)模擬除役過渡階段固定時間使水流動的狀況，冷抽(C)腐蝕速率為 $11\mu\text{m}/\text{year}$ ；(三)實驗(3)為模擬管路中水沒有充滿的狀態，熱軋(H)試片 a(空氣)、i(介面)與 w(水中)試片腐蝕速率分為 $9\mu\text{m}/\text{year}$ 、 $93\mu\text{m}/\text{year}$ 與 $88\mu\text{m}/\text{year}$ 。總結實驗(1)至(3)的實驗結果，碳鋼在實驗(3)空氣與水介面區域腐蝕速率最快，而在實驗(2)模擬固定使水流動的狀況腐蝕速率最慢。實驗(3)碳鋼在靜滯水中腐蝕速率主要受溶氧量與離子濃度影響，溶氧量為 1 至 6 ppm 等級時，離子濃度對腐蝕速率之影響大於溶氧量，且離子濃度越高腐蝕速率越快。實驗結果顯示氧濃度充足時，比較容易形成 FeOOH 或 Fe_2O_3 ，而相反的氧氣不充足的環境則容易生成 Fe_3O_4 。

Time 時間: 15:30-15:48, 10/16/2026

Location 地點: Lo Chia-Lun Lecture Hall 羅家倫講堂

Paper ID 論文編號: 1057

模擬乾式貯存實驗後用過核子燃料護套完整性 之非破壞檢驗

謝堯瀚^{1*}

¹ 國家原子能科技研究院

*Corresponding Author: Hsiehyaohan@nari.org.tw

為確保用過核子燃料之管理營運安全，核電廠用過燃料池貯存之用過核子燃料規劃移貯至乾式貯存設施，考量濕式貯存與乾式貯存之差異性，國原院規劃模擬乾式貯存實驗，設計特殊包封容器可調控溫度及不同氣氛條件來模擬實際乾式貯存環境，裝入用過核子燃料進行十年期模擬貯存實驗，每年定期取出用過核子燃料進行非破壞性檢驗獲取該年度燃料棒檢驗數據，藉由比較各年度數據來驗證乾式貯存可以維持用過核子燃料護套完整性。非破壞性檢驗項目包含：目視檢驗、外徑量測、渦電流探傷檢驗、氧化層厚度量測及 γ 輻射量測等。

Time 時間: 15:48-16:06, 10/16/2026

Location 地點: Lo Chia-Lun Lecture Hall 羅家倫講堂

Paper ID 論文編號: 1064

美國 IPEC 之燃料池外牆滲漏案例研析

張佐民^{1*}, 呂文豐¹

¹ 國家原子能科技研究院

*Corresponding Author: joeming@nari.org.tw

美國印地安角核電廠 (Indian Point Energy Center, IPEC) 坐落於紐約都會區近郊。2005 年，該廠於 2 號機燃料貯存廠房進行土方開挖時，於用過燃料池南側外露混凝土壁體發現微小收縮裂縫與水體滲流現象。經取樣分析，確認滲出水含有放射性核種氚；美國核能管制委員會 (Nuclear Regulatory Commission, NRC) 與營運單位隨即啟動應變與溯源調查。調查團隊採用目視檢測 (Visual Testing) 及真空盒洩漏試驗 (Vacuum Box Leakage Testing) 等多項非破壞檢測技術釐清瑕疵位置，並建置地下水監測網絡進行追蹤，確認各項放射性濃度皆遠低於美國法規限值，未對公眾健康與周邊環境造成實質影響。在滲漏機制方面，調查研判主要源於建廠施工與營運維護期間池內不銹鋼襯板所產生的細微損傷，導致池水漏入鋼板與混凝土牆體間的背襯夾層長期蓄積；後續因外側土方開挖解除側向土壓力，引起池壁結構受力重分配與微幅形變，進而促使既有收縮裂縫微幅開展並釋出夾層滯留水。本研究綜整印地安角核電廠 2005 年用過燃料池滲漏事件的成因調查、應變處置與非破壞檢測作業經驗，並檢視 ACI 349.3R-18 及 ACI 201.1R-08 等國際核能混凝土結構檢驗規範，歸納結構完整性評估與長期狀態監測之工程實務要點，期能提供國內相關混凝土建物在結構老化管理、檢測技術應用及工程維護上之參考。

Time 時間: 16:06-16:24, 10/16/2026

Location 地點: Lo Chia-Lun Lecture Hall 羅家倫講堂

Paper ID 論文編號: 1069

美國 Palisades 核電廠重啟檢測之蒸汽產生器管路破損案例研析

張佐民^{1*}, 呂文豐¹

¹ 國家原子能科技研究院 材料研究所

*Corresponding Author: joeming@nari.org.tw

本研究針對美國密西根州 Palisades 核電廠於除役後申請重啟運轉之關鍵非破壞檢測案例進行研析。該廠於 2022 年永久停機進入除役程序，隨後在聯邦與州政府能源政策支持下推動重啟，並依美國核能管制委員會(Nuclear Regulatory Commission, NRC)規範執行全面設備完整性檢測。於 1D28 重啟專案大修期間，檢測人員發現兩部蒸汽產生器之 Alloy 600 傳熱管存在高達 1.427 處材料劣化與腐蝕缺陷。分析指出，機組停機初期因未落實標準儲備程序（layup process），使管材長期暴露於停滯且含氧環境中，誘發應力腐蝕龜裂與局部腐蝕。營運商後續透過拔栓復原、增設套管補強及必要封塞等工程措施，以維持結構完整性。並經 NRC 嚴格審查。本案例具體顯示除役機組重啟評估中，材料老化管理、非破壞檢測精準度及監管把關之技術關鍵性。

Time 時間: 16:24-16:42, 10/16/2026

Location 地點: Lo Chia-Lun Lecture Hall 羅家倫講堂

Paper ID 論文編號: 1095

核電廠乾式貯存密封鋼筒銲接之非破壞檢測作業

李建洲^{1*}

¹ 國家原子能科技研究院材料研究所

*Corresponding Author: jjlee@nari.org.tw

用過核子燃料乾式貯存系統以密封鋼筒作為放射性物質的主要屏障，其壓力邊界完整性直接關係到貯存安全，本文依 ASME Boiler and Pressure Vessel Code Section III 對核能組件壓力邊界之規範，探討密封鋼筒在製造階段及裝填燃料後封鐸階段所採用之非破壞檢測技術，製造階段涵蓋外殼軸向與周向鐸道之射線檢測與超音波檢測，以及底板對外殼鐸道之檢測；封鐸階段則以漸進式液滲檢測為核心，輔以氦氣洩漏測試與水壓測漏，確保雙重密封邊界之完整性，本文旨在為非破壞檢測從業人員提供核能乾式貯存領域之技術參考。

Time 時間: 16:42-17:00, 10/16/2026

Location 地點: Lo Chia-Lun Lecture Hall 羅家倫講堂

Paper ID 論文編號: 1108

以中子繞射方法研究銅質材料腐蝕行為

雍敦元 ^{1*}, 呂文豐 ¹, 蔡坤釗 ¹, 李文献 ²

¹ 國家原子能科技研究院材料所

² 東吳大學物理學系

*Corresponding Author: tyjung@nari.org.tw

本研究利用中子繞射技術進行無氧銅材料模擬核電廠除役後地質環境之腐蝕實驗分析，包含下列實驗:(一)實驗(1)pH7 模擬地下水有氧條件(編號 Cu01~Cu05)；(二)實驗(2)pH6.5 模擬地下水有氧條件(編號 Cu006~Cu10)。總結實驗(1)和(2)的實驗結果，無氧銅在實驗(1)腐蝕行為經中子繞射分析發現只有銅基材的訊號，而在實驗(2)在微酸性條件下，可以觀察到氧化亞銅的腐蝕產物。

C-SS7: Civil NDT, 土木非破壞檢測

Session Chair: Keng-Tsang Hsu

主持人: 許耿蒼

Time 時間: 15:12-16:42, 10/15/2026

Location 地點: Glass Classroom 玻璃屋

Time 時間	Paper ID 論文編號	Title 演講題目	Authors 作者
15:12-15:30	1007	船用減速機冷卻器管渦電流檢測	林財得, 許家逢, 柳彥祺
15:30-15:48	1032	PAUT、TOFD、TFM、PCI 對於 銲道瑕疵方向性檢出能力探討	黎家銘, 黃啟貞, 黃炳森, 郭榆承, 陳煜琦, 邱雍惟, 曾科毓
15:48-16:06	1082	利用格雷碼結合四步相移方法於 珊瑚三維量測研究	陳又維, 蕭涵翊, 溫博浚
16:06-16:24	1086	以紅外線熱影像技術評估螺栓結 合狀況之初步研究	許耿蒼, 廖偉丞, 黃丞頤
16:24-16:42	1096	多元監檢測技術於堤岸防汛道路 安全監測之實務應用	許耿蒼, 洪嘉鍵, 張昀萱

Time 時間: 15:12-15:30, 10/15/2026

Location 地點: Glass Classroom 玻璃屋

Paper ID 論文編號: 1007

船用減速機冷卻器管渦電流檢測

林財得^{1*}, 許家逢¹, 柳彥祺¹

¹ 台灣電力公司第三核能發電廠

*Corresponding Author: u419883@taipower.com.tw

針對海巡署雲林艦前、後機艙減速機冷卻管進行四次渦電流檢測。排除鐵磁性堆積物干擾後，冷卻管並無顯著劣化。建議每次返港後需定期清洗冷卻管，減少堆積物阻礙冷卻水流通，以提升熱傳效率並降低腐蝕風險。檢測週期可依原廠操作手冊每三個月執行，再依實際結果調

整。若發現可能破管，應立即塞管以維持冷卻系統完整性。本文說明從現場進入船艙內部實勘及探頭採購與擷取製作標準管素材，標準管設計加工製作，檢測參數設定及現場檢測過程及結果。

Time 時間: 15:30-15:48, 10/15/2026

Location 地點: Glass Classroom 玻璃屋

Paper ID 論文編號: 1032

PAUT、TOFD、TFM、PCI 對於鐸道瑕疵方向性檢出能力探討

黎家銘^{1*}, 黃啟貞¹, 黃炳森¹, 郭榆承¹, 陳煜琦¹, 邱雍惟¹, 曾科毓¹

¹ 台灣金屬材料品管有限公司

*Corresponding Author: tmqndt@tmqc.com.tw

近年來輻射防護安全意識抬頭，從大型發電廠、石化廠、鐵工廠與檢測從業人員都開始多加利用先進的檢測技術來替代 RT，進行超音波檢測時無須將附近的人疏散，不會影響現場管線配置人員的施工品質與速度。超音波的優勢是能夠快速的得到內部瑕疵的檢驗結果，對運轉中設備檢測出內部是否有微小的裂紋產生，以及圖像的顯示可以增加檢測人員訊號判讀的能力，不再讓微小裂紋被忽略。而傳統超音波無法將訊號連續記錄，因此能將 訊號圖像記錄的相位陣列式超音波(PAUT)與飛行時間繞射法(TOFD)成為技術較為成熟的超音波，現在有較為新的技術是從全矩陣擷取(FMC) 裡延伸出來的兩種檢測技術分別是 TFM(全聚焦法)及 PCI(相位相干成像)，其中 FMC 是一種資料收集技術，探頭中的每一個晶片單元依序作為發射器，並讓所有晶片單元同時接收回波，記錄下原始訊號的 A-scan 資料矩陣。而 TFM 是透過演算法，將 FMC 收集到的龐大數據進行延時與疊加，計算出檢測區域內每一個像素點的聚焦訊號，組合成一幅高解析度的 2D 影像；PCI 是 TFM 的無振幅變體，它以 FMC 所選定的波組來收集數據。對信號捨棄振幅而僅保留相位，再經分析各 A-scan 的延遲信號的相位頻散來比較相位相干性而創建 TFM 圖像[1]，其高清晰度與信噪比：能有效降低結構雜訊與偽像 (Artifacts)，對微小或低反射率的缺陷極端敏感。以上三種技術均能檢出焊道內部的

裂紋，所以本文分別以 PAUT+TOFD 及 PAUT+TFM/PC 對於鐸道中瑕疵裂紋的檢出能力、裂紋深淺(高度)及訊號判讀難易列入考慮，以規塊及試片實驗來作比較分析和探討。希望藉此了解新技術的鑑別能力作為檢測程序制定之參考或依據。

Time 時間: 15:48-16:06, 10/15/2026

Location 地點: Glass Classroom 玻璃屋

Paper ID 論文編號: 1082

利用格雷碼結合四步相移方法於珊瑚三維量測研究

陳又維^{1*}, 蕭涵翊¹, 溫博浚¹

¹ 國立臺灣海洋大學機械與機電工程學系

*Corresponding Author: owentw87@gmail.com

本研究建立二值格雷碼結合四步相移之結構光三維量測流程，並以階梯與珊瑚試件進行空氣介質量測。珊瑚所選平坦區中，純四步相移與格雷碼輔助方法之峰谷值分別為 5.12 mm 與 3.56 mm，區域標準差分別為 1.00 mm 與 0.98 mm；階梯所選平坦區兩法之峰谷值皆為 1.00 mm，標準差皆為 0.17 mm。格雷碼輔助結果可減少部分相位展開異常尖峰；惟絕對高度準確度及重複量測精密性仍需以共同參考平面、已知尺寸標準件及多次量測進一步驗證。

Time 時間: 16:06-16:24, 10/15/2026

Location 地點: Glass Classroom 玻璃屋

Paper ID 論文編號: 1086

以紅外線熱影像技術評估螺栓結合狀況之初步研究

許耿蒼^{1*}, 廖偉丞¹, 黃丞頤¹

¹ 朝陽科技大學營建工程系

*Corresponding Author: charlie92928@gmail.com

本研究探討以紅外線熱影像技術進行非接觸式螺栓鬆脫檢測之可行性。鋼結構螺栓常因疲勞與外力產生鬆脫，傳統接觸式扭力扳手檢測耗時費力且難以涵蓋大範圍。本實驗以 H 型鋼接合試體，配置 8 顆 M12 螺栓為對象，利用震動馬達注入動能模擬外部載荷。透過施加 1.3 N·m 至 122 N·m 等 10 階段扭力，並以熱像儀記錄摩擦溫升變化。數據經高斯平滑濾波與 5*5 像素區域平均後計算相對溫差。結果顯示，低扭力下溫升曲線高度分散；達設計規範時，接觸面緊密，各螺栓溫升趨勢高度一致。此方法能有效評估預緊力狀態，具大面積檢測潛力。

Time 時間: 16:24-16:42, 10/15/2026

Location 地點: Glass Classroom 玻璃屋

Paper ID 論文編號: 1096

多元監檢測技術於堤岸防汛道路安全監測之實務應用

許耿蒼¹, 洪嘉鍵¹, 張昀萱^{1*}

¹ 朝陽科技大學營建工程系

*Corresponding Author: cys31779567@gmail.com

本文案例之主要檢測對象為防汛道路，因該區段重複發生沉陷破壞情形，尚存在持續變形之潛在風險。綜合受損紀錄及河道地形條件，從 115 年 3 月開始做監測，並整合自動化無線傾斜計、全測站沉陷觀測釘及 RTK UAV 航測進行安全監測。而監測區域於 115 年 7 月初發生堤頂孔洞沉陷之問題，本文將針對相關監測成果進行災後檢討，並利用不同期次 UAV 三維點雲於 Trimble RealWorks 進行沉陷差異比對。結果顯示沉陷觀測釘監測未明顯反映局部沉陷變化，而點雲相較之下比較可辨識局部高程差異。後續建議於高風險區段適度增加沉陷觀測密度，且可考慮以 SLAM LiDAR 進行更高精度掃描，建立完善點雲模型，以提升整體監測完整性。

E-R1: Advanced NDT Technologies and Applications, 先進非破壞檢測與應用

Session Chair: Chan-Yi Liao

主持人: 廖展誼

Time 時間 : 13:00-14:48, 10/16/2026

Location 地點 : Glass Classroom 玻璃屋

Time 時間	Paper ID 論文編號	Title 演講題目	Authors 作者
13:00-13:18	1006	Advanced Ultrasound Methods for HTHA Inspection	Dennis Chai, Stéphan Couture
13:18-13:36	1025	Fluid-Structure Coupled Dynamic Response of a Partially Submerged Plate Subjected to an Underwater Spark Discharge Wave Source	Hao-Chun Ho, Chan-Yi Liao
13:36-13:54	1044	Integrated Real-Time Diagnosis of Phase Changes in Freeze-Drying Using Ultrasonic Transducers and Optical Methods	Chin-Chi Cheng, Chien-An Lin, Zhe-Rui Liu, Shih-Chang Huang, Jing-Xuan Huang, Hong-Ping Cheng
13:54-14:12	1058	A Handheld Spherical Sensor for Multidirectional NDT Surface Inspection with Machine Learning-Based Classification	Edmun Iro Kavalo Halawa, Wei-Song Hung, Po Ting Lin
14:12-14:30	1070	Single-Shot Polarization Interferometry with Enhanced Sampling Density for Optical Surface Profile Measurement	Hsing-Hsien Tsai, Ju-Yi Lee
14:30-14:48	1088	FEA Based Sensor Placement and Long Term Acoustic Emission Monitoring of A Large Structure	Jonghwan Park, Suksan Ok, Yeongil Choi, Do-Kyung Pyun, Jaesun Lee

Time 時間: 13:00–13:18, 10/16/2026

Location 地點: Glass Classroom 玻璃屋

Paper ID 論文編號: 1006

Advanced Ultrasound Methods for HTHA Inspection

Dennis Chai^{1*}, Stéphan Couture¹

¹Evident Singapore

*Corresponding Author: dennis.chai@evidentscientific.com

High temperature hydrogen attack (HTHA), also called hot hydrogen attack, is a problem which concerns steels operating at elevated temperatures (above 400°C) in hydrogen environments, in refinery, petrochemical and other chemical facilities and, possibly, high pressure steam boilers. HTHA is the result of hydrogen dissociating and dissolving in the steel, and then reacting with the carbon in solution in the steel to form methane bubbles. This can result in either surface decarburization, when the reaction mostly occurs at the surface and draws carbon from the material, or internal decarburization when atomic hydrogen penetrates the material and reacts with carbon to form methane, which accumulates at grain boundaries and/or precipitate interfaces and cannot diffuse out of the steel. This causes the fissures and cracking which are typical of HTHA. The main challenge is characterization, to help evaluate fitness for service and avoid false positives: (1) Small cracks are difficult to distinguish from inclusions, (2) HTHA-induced cracking is hard to distinguish from other damage mechanisms, (3) Defining cracks and clusters requires very fine resolution. This presentation reviews some common challenges and key considerations of HTHA inspection, goes over the API standard updates, and explores the potential of recent innovations in probe design and signal processing.

Time 時間: 13:18–13:36, 10/16/2026

Location 地點: Glass Classroom 玻璃屋

Paper ID 論文編號: 1025

Fluid-Structure Coupled Dynamic Response of a Partially Submerged Plate Subjected to an Underwater Spark Discharge Wave Source

Hao-Chun Ho^{1*}, Chan-Yi Liao¹

¹Department of Mechanical Engineering, National Central University

*Corresponding Author: s10355003@gmail.com

This study investigates the fluid-structure coupled dynamic response of a partially submerged plate subjected to an underwater spark-discharge wave source through an integrated framework of theoretical analysis, finite element calculations, and experimental measurements. A semi-analytical method is first developed based on thin-plate theory and incompressible potential-flow theory, with the dry-mode shapes and fluid-response characteristics obtained from finite element analysis. An underwater spark-discharge experimental system is then constructed, and the transient out-of-plane displacement of the plate is measured using a laser displacement sensor. Because the source-time history of the spark discharge cannot be measured directly, it is represented by a parameterized function and reconstructed using a finite element model combined with the Levenberg-Marquardt optimization method. The results show good agreement between the semi-analytical and finite element solutions. The reconstructed source also reasonably reproduces the transient plate responses under different water depths, measurement positions, and electrode gaps.

Time 時間: 13:36–13:54, 10/16/2026

Location 地點: Glass Classroom 玻璃屋

Paper ID 論文編號: 1044

Integrated Real-Time Diagnosis of Phase Changes in Freeze-Drying Using Ultrasonic Transducers and Optical Methods

Chin-Chi Cheng^{1*}, Chien-An Lin¹, Zhe-Rui Liu¹, Shih-Chang Huang¹,
Jing-Xuan Huang¹, Hong-Ping Cheng¹

¹Department of Energy and Refrigerating Air-Conditioning Engineering, National
Taipei University of Technology

*Corresponding Author: newmanch@mail.ntut.edu.tw

Precise diagnostics during the freezing stage and accurate detection of the sublimation end point are critical for ensuring product quality and achieving energy efficiency in freeze-drying (lyophilization) processes. Traditional contact-type temperature sensors (thermocouples) carry a risk of sample contamination and frequently detach as the ice structure shrinks during drying, leading to sensor failure. This study integrates an advanced sol-gel sprayed ultrasonic transducer (UT) technology with visual image diagnosis to monitor the real-time physical property variations of pure water and saline solutions of various concentrations (0.9 wt%, 5 wt%, and 10 wt%) during freezing and drying. The experimental results demonstrate that the non-intrusive UT system accurately identifies key process stages—including water loading, freezing point, and phase change end—by tracking the amplitude and sound velocity shifts of L3 and Lw ultrasonic echoes. Water level and shelf temperature exhibit clear linear correlations with cooling and freezing durations, while increasing saline concentration significantly hinders ice crystal growth. In a 15 mm water level test, this technology successfully reduced the process time by 134.4 minutes, achieving an approximately 13% reduction in energy consumption. This integrated method provides a non-destructive, highly energy-efficient smart diagnostic solution for industrial freeze-drying applications.

Time 時間: 13:54–14:12, 10/16/2026

Location 地點: Glass Classroom 玻璃屋

Paper ID 論文編號: 1058

A Handheld Spherical Sensor for Multidirectional NDT Surface Inspection with Machine Learning-Based Classification

Edmun Iro Kavalo Halawa¹, Wei-Song Hung², Po Ting Lin^{1*}

¹Department of Mechanical Engineering, National Taiwan University of Science and Technology

²Graduate Institute of Applied Science and Technology, National Taiwan University of Science and Technology

*Corresponding Author: potinglin@mail.ntust.edu.tw

Handheld spherical sensors offer a practical approach for continuous non-destructive testing (NDT) of engineering surfaces. However, conventional cylindrical sensing configurations are inherently constrained by their fixed rolling axis, limiting their movement primarily to forward and backward scanning. This directional restriction reduces inspection flexibility when multidirectional exploration of a two-dimensional surface is required. To address this limitation, this study proposes a handheld spherical sensing system for multidirectional NDT surface inspection. The spherical geometry eliminates the fixed rolling direction of cylindrical configurations and enables the sensing platform to move in different planar directions without mechanical reorientation. An inertial measurement unit (IMU) is integrated within the spherical body to measure rotational motion and support orientation and inspection-trajectory estimation during rolling. Surface-interaction signals acquired during scanning are subsequently classified using three supervised machine-learning algorithms: support vector machine (SVM), random forest (RF), and k-nearest neighbors (KNN). By integrating trajectory estimation with signal classification, the proposed framework is designed to associate identified surface conditions with their corresponding positions along the inspection path. The proposed spherical architecture provides a foundation for flexible, multidirectional, and spatially referenced handheld NDT inspection while addressing the directional limitations of conventional cylindrical rolling sensing systems.

Time 時間: 14:12–14:30, 10/16/2026

Location 地點: Glass Classroom 玻璃屋

Paper ID 論文編號: 1070

Single-Shot Polarization Interferometry with Enhanced Sampling Density for Optical Surface Profile Measurement

Hsing-Hsien Tsai^{1*}, Ju-Yi Lee¹

¹Department of Mechanical Engineering, National Central University

*Corresponding Author: 111383012@cc.ncu.edu.tw

Non-destructive optical metrology requires high-resolution surface profiling. However, conventional single-shot polarization interferometry is limited by its 2×2 pixel configuration. To overcome this, we propose an enhanced phase sampling technique using all four channels of a polarization camera. Experiments show a fourfold improvement in sampling density, enabling high-precision profile measurement with reduced phase error.

Time 時間: 14:30–14:48, 10/16/2026

Location 地點: Glass Classroom 玻璃屋

Paper ID 論文編號: 1088

FEA Based Sensor Placement and Long Term Acoustic Emission Monitoring of a Large Structure

Jonghwan Park¹, Suksan Ok¹, Yeongil Choi¹, Do-Kyung Pyun^{2*},
Jaesun Lee^{2*}

¹Department of Mechanical Engineering, Changwon National University

²School of Mechanical Engineering, Changwon National University

*Corresponding Authors: dpyun@changwon.ac.kr, jaesun@changwon.ac.kr

Acoustic emission (AE) monitoring is sensitive to active damage, but its performance on large welded structures depends strongly on sensor placement. This study combined transient finite element wave-propagation analysis with long-duration repeated-load testing to select and assess AE sensor locations. Representative source regions were defined from previous damage observations, and candidate positions were ranked using normalized peak responses to a common windowed excitation. Positions near vulnerable regions and on continuous plate paths generally retained stronger responses. A distributed sensor array was installed at the selected positions during two test campaigns. Absolute energy was processed using a moving mean equal to one loading cycle. During the longer campaign, sustained increases in energy appeared before inspection identified a nearby crack, and the closest sensor showed the clearest change. The shorter campaign ended after another defect was found, although the available record showed no comparable energy surge. The results support FEA as a practical placement tool, while incomplete acquisition, unequal sensor responses, and the absence of continuous crack measurements prevent determination of the exact crack initiation time.

E-R2: Metrology, 量測

Session Chair: Ju-Yi Lee

主持人: 李朱育

Time 時間：13:00-14:30, 10/16/2026

Location 地點：Future Classroom 未來教室

Time 時間	Paper ID 論文編號	Title 演講題目	Authors 作者
13:00-13:18	1046	Rotation Angle Measurement Using A Holographic Radial Grating with Heterodyne Interferometry	Chun-Yi Chang, Che-An Yang, Ju-Yi Lee, Cheng-Chih Hsu
13:18-13:36	1062	Measurement of the Refractive Index of Prism with the Maximum Phase Difference of Total-Internal Reflection and Polarization Camera	Yi-Ying Lin, Tzu-Mo Lee, Chia-Yu Chiang, Ju-Yi Lee
13:36-13:54	1068	Measurement of Roll Angular Displacement Using Dual-Beam Polarization Interferometry	Shang-Wei Cai, Ching-Tse Hsu, Shu-Han Chang, Wun-Yan Chen, Ju-Yi Lee
13:54-14:12	1079	Surface Topography Measurement Based on Polarization Interferometry	Tzu-Mo Lee, Wun-Yan Chen, Yue-Jhe Tsai, Ju-Yi Lee
14:12-14:30	1080	Instantaneous Wave Plate Measurement with Phase Retardation and Fast Axis Azimuth	Wei Chen, Wei-Cheng Wong, Chia-Yu Chung, Ju-Yi Lee

Time 時間：13:00-13:18, 10/16/2026

Location 地點：Future Classroom 未來教室

Paper ID 論文編號：1046

Rotation Angle Measurement Using a Holographic Radial Grating with Heterodyne Interferometry

Chun-Yi Chang^{1*}, Che-An Yang², Ju-Yi Lee¹, Cheng-Chih Hsu²

¹Department of Electro-Optical Engineering, National United University

²Institute of Opto-Mechatronics Engineering, National Central University

*Corresponding Author: 114387001@cc.ncu.edu.tw

A compact optical architecture is proposed for high-resolution rotation angle measurement using a holographic radial grating combined with differential heterodyne phase-locked detection. The angular information is extracted from the differential phase between the +1 and -1 diffraction orders generated at a single incident position on the grating, whose radial location is defined by a controllable incident light position module (CILPM). In practical rotary systems, axis misalignment and eccentricity between the rotation center and the metrological reference introduce parasitic radial translation, which couples into the angular reading and degrades measurement accuracy. Because this translation-induced phase appears identically in both diffraction orders, the proposed differential configuration rejects it as a common-mode component while preserving the phase term proportional to the rotation angle, thereby relaxing the mechanical mounting and alignment tolerances normally required. The system was validated against a commercial optical encoder over three kinematic regimes, covering sub-degree motion to continuous 360° rotation at angular velocities up to 5°/sec. A static angular resolution better than $1 \times 10^{-4}^\circ$ was demonstrated, exceeding the quantization limit of the reference encoder, and the measured angle remained insensitive to incident beam diameters from 1 mm to 3 mm.

Time 時間: 13:18–13:36, 10/16/2026

Location 地點: Future Classroom 未來教室

Paper ID 論文編號: 1062

Measurement of the Refractive Index of Prism with the Maximum Phase Difference of Total-Internal Reflection and Polarization Camera

Yi-Ying Lin^{1*}, Tzu-Mo Lee¹, Chia-Yu Chiang¹, Ju-Yi Lee¹

¹Department of Mechanical Engineering, National Central University

*Corresponding Author: 91tinalin22@gmail.com

This study proposes a high-precision refractive index measurement technique based on total internal reflection (TIR) common-path polarization interferometry for irregular optical components, including

prisms, aspherical lenses, and cylindrical lenses. Polarization interferometric phase demodulation is employed to determine the maximum phase difference induced by TIR, from which the refractive index is derived. Since TIR occurs at the sample–air interface, no index-matching liquid is required. A polarization camera integrated into the common-path configuration simultaneously captures multiple polarization states, simplifying the optical setup and improving measurement speed. With the maximum phase difference as the sole parameter in the measurement equation, the proposed method achieves a refractive index resolution of up to 1.6×10^{-3} RIU.

Time 時間: 13:36–13:54, 10/16/2026

Location 地點: Future Classroom 未來教室

Paper ID 論文編號: 1068

Measurement of Roll Angular Displacement Using Dual-Beam Polarization Interferometry

Shang-Wei Cai^{1*}, Ching-Tse Hsu¹, Shu-Han Chang¹, Wun-Yan Chen¹,
Ju-Yi Lee¹

¹Department of Mechanical Engineering, National Central University

*Corresponding Author: 115327004@cc.ncu.edu.tw

Dual-beam polarization interferometry is examined for roll angular displacement measurement with reduced sensitivity to incidence-angle disturbances. Four polarization-resolved intensity signals are used to retrieve the phase retardation induced by a birefringent crystal. Averaging the phases of two symmetrically incident beams cancels the first-order disturbance contribution. Experiments reported in the source study demonstrate a measurement range of 10° . Under time-varying incidence-angle disturbances within $\pm 1^\circ$, the mean error and standard deviation are 0.0017° and 0.0095° , respectively. The reported estimated resolution is 0.58 arcsec. Signal fluctuations and periodic nonlinear errors are also discussed.

Time 時間: 13:54–14:12, 10/16/2026

Location 地點: Future Classroom 未來教室

Paper ID 論文編號: 1079

Surface Topography Measurement Based on Polarization Interferometry

Tzu-Mo Lee^{1*}, Wun-Yan Chen¹, Yue-Jhe Tsai¹, Ju-Yi Lee¹

¹Department of Mechanical Engineering, National Central University

*Corresponding Author: 114327007@cc.ncu.edu.tw

This study presents a full-field wafer surface topography measurement method based on Fizeau-type polarization interferometry. A polarization camera is used to capture the interference signal and simultaneously obtain four phase-shifted interferograms. The wafer surface topography is then reconstructed by applying a phase-shifting algorithm to the acquired interferograms. Since only a single image acquisition is required, the proposed method enables rapid measurement and is suitable for continuously curved surfaces and polished materials with different reflectivities.

Time 時間: 14:12–14:30, 10/16/2026

Location 地點: Future Classroom 未來教室

Paper ID 論文編號: 1080

Instantaneous Wave Plate Measurement with Phase Retardation and Fast Axis Azimuth

Wei Chen^{1*}, Wei-Cheng Wong¹, Chia-Yu Chung¹, Ju-Yi Lee¹

¹Department of Mechanical Engineering, National Central University

*Corresponding Author: ts9940306@gmail.com

This work proposes an instantaneous measurement method for wave plate phase retardation and fast-axis azimuth. A polarization camera acquires four intensity signals at 0°, 45°, 90°, and 135° in a single frame. The proposed polarization-interferometric calculation retrieves phase retardation from the

intensity ratio and locates the fast axis from the maximum slope of the phase-difference curve. The optical setup reduces the need for beam splitting and moving analyzer components while maintaining high repeatability.

C-R1: Ultrasonic Testing (UT), 超音波檢測

Session Chair: Wen-Chuan Wu

主持人: 吳文銓

Time 時間：15:12-16:42, 10/16/2026

Location 地點：Glass Classroom 玻璃屋

Time 時間	Paper ID 論文編號	Title 演講題目	Authors 作者
15:12-15:30	1002	利用 ADTTU 檢測技術進行複材內部缺陷偵測研究	陳世峯, 蕭天文
15:30-15:48	1009	天然氣電廠熱回收鍋爐汽鼓鐸道相位陣列超音波檢測	陳豪韋, 李任翔, 蘇兩傳
15:48-16:06	1018	陣列式超音波全聚焦法 (PAUT-TFM) 於卸船機液壓桿環形鉤檢測之應用	楊智詠, 邱柏誠
16:06-16:24	1034	離岸風電管架銲接橫向裂縫問題改善經驗	董寶鴻
16:24-16:42	1066	TFM 與 PCI 檢測技術之功能驗證與設定	郭佳揚, 黃啟貞

Time 時間：15:12-15:30, 10/16/2026

Location 地點：Glass Classroom 玻璃屋

Paper ID 論文編號：1002

利用 ADTTU 檢測技術進行複材內部缺陷偵測研究

陳世峯^{1*}, 蕭天文²

¹漢翔公司品質工程組

²漢翔公司製造品管課

*Corresponding Author: shihfengchen@ms.aidc.com.tw

碳纖維增強複合材料（CFRP）因具備高比強度與輕量化優勢，廣泛應用於先進航太與國防結構中。然而，針對 6 至 14 層（約 1.5 至 3.5 mm）的薄件 CFRP 結構，傳統非破壞檢測面臨巨大挑戰：浸水式自動化脈波回波法（PE UT C-scan）極易受到薄件結構剛性低（較軟）與易變形之影響，導致探頭在掃描時難以與不平整的複材表面保持絕對垂直，引發聲束折射失真，且其波形常受表面反射波尾隨振盪重疊之遮蔽，極難準確識別薄件內部缺陷；而傳統單次穿透法（TT UT）雖無表面不垂直與波形重疊限制，但因聲波僅單次穿透試件，對微小孔隙（Porosity）所引起的微弱散射與衰減變化不夠敏感，導致孔隙定量化評估極為困難。為克服上述薄件易變形無法維持垂直度及孔隙不敏感等技術瓶頸，本研究引進自動雙穿透式超音波檢測技術（Automatic Double Through Transmission Ultrasonic, ADTTU / DTTU C-scan）。本研究整合多軸機械手臂、相位陣列超音波（PAUT）探頭與高平整度玻璃反射板，並以符合工業界實務需求的檢測規範為導向，旨在建立一套針對薄件 CFRP 內部脫層、孔隙率及異物缺陷的高效能自動化掃描與後處理數據分析流程。

Time 時間: 15:30–15:48, 10/16/2026

Location 地點: Glass Classroom 玻璃屋

Paper ID 論文編號: 1009

天然氣電廠熱回收鍋爐汽鼓鐸道相位陣列超音波檢測

陳豪韋¹, 李任翔¹, 蘇兩傳^{1*}

¹台灣電力公司第三核能發電廠

*Corresponding Author: u810299@taipower.com.tw

本文介紹目前國內天然氣發電廠，機組型式為一套多軸式燃氣複循環發電機系(2gt+1st)，包括美國奇異公司的兩組氣渦輪發電機、日本東芝公司製造的壹組汽輪發電機、韓國斗山公司製造的兩組熱回收鍋爐和及香港 spx 公司製造的壹組氣冷式冷凝器，裝置容量達 490Mw[1]。熱回收鍋爐上方分別有低壓、中壓及高壓汽鼓，本案於發生火災後重建需要，藉由檢查上述 3 個鍋爐汽鼓鐸道現況，以確保鍋爐汽鼓的安全性和可靠性。由於汽鼓厚度不適宜使用射線

照像，改使用相位陣列超音波檢測[2]，本文說明上述 3 個鍋爐汽鼓鐸道使用相位陣列超音波檢測過程及結果。

Time 時間: 15:48–16:06, 10/16/2026

Location 地點: Glass Classroom 玻璃屋

Paper ID 論文編號: 1018

陣列式超音波全聚焦法（PAUT-TFM）於卸船機液壓桿環形鉤檢測之應用

楊智詠^{1*}, 邱柏誠¹

¹ 中鋼公司智財與檢測技術處非破壞檢驗課

*Corresponding Author: 167528@mail.csc.com.tw

連續式卸船機於卸貨作業中升降液壓桿發生突然斷裂，導致產線中斷。經拆解檢視發現，斷裂發生於液壓桿與環形鉤銜接處。由於外部包覆防塵套、環形鉤平時無法拆卸，且液壓桿內部具有齒溝與加工槽等複雜幾何結構，傳統超音波檢測（UT）須藉由破斷試片比對、多角度探頭分別評估訊號可能位置，方能判讀瑕疵訊號，單次線上全周檢測作業時間約需 20 分鐘，效率與判讀難度均受限。為提升檢測效率與訊號解析度，本研究導入相控陣列全聚焦法（Total Focusing Method, TFM）進行檢測。透過多個陣列探頭元件依序發射、全元件同步接收之方式，取得完整全矩陣捕獲（Full Matrix Capture）訊號，再以聚焦演算法重建各像素點之高解析度影像，克服傳統 PAUT 單一聚焦法則之解析度限制，可清楚呈現齒面、加工槽與內部瑕疵之相對位置與型態。現場驗證結果顯示，TFM 檢測可於大幅縮短全周掃描與影像判讀作業時間，較傳統方式縮短約 7 成，且影像判讀直觀、瑕疵定位精確，大幅降低人為判讀誤差風險。基於本次案例經驗，該廠已將環形鉤、液壓桿納入年度定期檢測項目，優先採用 TFM 檢測技術，以提升類似複雜幾何結構關鍵零組件之檢測效率與可靠度。

Time 時間: 16:06–16:24, 10/16/2026

Location 地點: Glass Classroom 玻璃屋

Paper ID 論文編號: 1034

離岸風電管架銲接橫向裂縫問題改善經驗

董寶鴻^{1*}

¹興達海洋基礎公司

*Corresponding Author: paohongtong@gmail.com

離岸風機管架(Jacket)水下基礎，因為構造複雜與板厚甚厚，在製造與非破壞檢驗上和傳統陸上鋼結構的製造與檢驗上有明顯差異。台灣地區發展離岸風電初期，因為經驗不足，而有不少銲接問題發生。本文以銲道發生橫裂問題的製造與檢驗問題，分析出主要原因在於 (1) 銲接預熱不足(2)UT 對於橫裂的檢驗經驗不足 (3) 銲接與檢驗時間間隔 48 小時的追溯紀錄未落實等因素所導致。經過提出改善措施落實執行之後，離岸風機管架已經順利完成，使離岸風機能順利提供台灣綠能的需要。

Time 時間: 16:24–16:42, 10/16/2026

Location 地點: Glass Classroom 玻璃屋

Paper ID 論文編號: 1066

TFM 與 PCI 檢測技術之功能驗證與設定

郭佳揚^{1*}, 黃啟貞¹

¹台灣金屬材料品管有限公司

*Corresponding Author: mysteryxd@hotmail.com

隨著 ASME BPVC Sec.V 於 2025 年版更新，目前已將 TFM (Total Focusing Method)全聚焦超音波檢測技術納入 Article.3 自成一個篇章；此外 ISO 也於 2021 年分別推出 ISO-23864(銲道非破壞檢測-採用全自動 TFM 檢測與相關技術)與 ISO-23865(非破壞檢測-超音波-TFM 與相關檢

測技術通則)，故本文章將以 TFM 之技術原理實際探討功能驗證以及使用限制。內容首先介紹 FMC (Full Matrix Capture)全矩陣資料收集，再來解說如何透過 FMC 所獲得的矩陣資料來完成 TFM 與 PCI (Phase coherence imaging)，最後透過實驗比較來說明檢測時儀器如何設定、參數如何選擇以及檢測上有何限制。

Author/Chair Index 作者/主席索引

A

- Abidin, Ilham Mukriz Zainal 54
Aslam, Mohammed 45

C

- Cai, Shang-Wei 148
Cao, Ting-Hao 99
Chai, Dennis 140
Chan, Min-Hsin 92
Chang, Chun-Yi 146
Chang, Joe-Ming 78, 130, 132, 133
Chang, Ming-Hung 47
Chang, Shao-Yu 49
Chang, Shih-Hsin 49
Chang, Shu-Han 148
Chang, Tzu-Hsiang 98
Chao, Yi-Kai 62
Chen, Ching-Chi 45, 60, 67
Chen, Chun-Pin 102
Chen, Hsing-Yu 103
Chen, Jen-Hung 54
Chen, Jing-Heng 92, 98
Chen, Kun-Huang 98, 113
Chen, Liang-Chia 41
Chen, P.K. 52
Chen, Pei-Chun 103
Chen, Wei 99, 149
Chen, Wei-Long 63
Chen, Wun-Yan 148, 149
Chen, Yu-An 61
Cheng, Chau-Jern 93, 101
Cheng, Chin-Chi 142
Cheng, Hong-Ping 142
Cheng, Kent 52
Cheng, Nai-Jen 85, 94
Cheng, Shun-Yuan 47
Chiang, Chia-Yu 147
Chiang, Chih-Hung 37, 60, 63, 67, 106
Chien, Ting-Yu 65
Cho, Younho 39
Choi, Yeongil 66, 144
Chu, Minheon 94
Chung, Chia-Yu 149
Couture, Stéphan 140

F

- Fan, Chun-Yuan 90
Fu, Wei-En 49

G

- Gowda B V, Jayanth 106
Gunawan, Hariyanto 103

H

- Halawa, Edmun Iro Kavalo 143

- Ho, Hao-Chun 141
Hong, Rui-Hong 85
Hsieh, Cheng-Che 98
Hsieh, Chia-Che 49
Hsieh, Hung-Lin 97, 100, 102
Hsieh, Yu-Yi 100
Hsien, Liu-Chao 63
Hsu, Cheng-Chih 146
Hsu, Chih-Cheng 93
Hsu, Ching-Tse 148
Hsu, Chun-Jui 110
Hsu, Jiong-Shiun 96
Hsu, Jung-Yen 91
Hsu, Keng-Tsang 135, 138
Hu, Yan-Cheng 99
Huang, Bo-Hao 85, 94
Huang, Cheng-Ting 92
Huang, Chung-Hsuan 93, 101
Huang, Jing-Xuan 142
Huang, Ping-Sheng 72, 86, 136
Huang, Shih-Chang 142
Huang, Yennun 65
Huang, Yu-Hsi 39, 67, 126
Hung, Nai-Jen 91
Hung, Wei-Song 143

I

- I, Boris 45, 95

J

- Jeng, Jin-Jhy 72, 86
Jhong, Bo-Siang 92
Jung, Gye Jo 59, 109

K

- Kim, Hunhee 66
Kumar, David 63, 106
Kuo, Hsin-Yi 58, 108
Kuo, Po-Yuan 96

L

- Lai, Yi-Min 87
Lee, Jaesun 45, 66, 95, 144
Lee, Ju-Yi 41, 99, 144, 146, 147, 148, 149
Lee, Ping Hung 123, 124, 125
Lee, Tzu-Mo 147, 149
Lee, Yu-Ching 58, 108, 110
Li, Jia-Ying 100
Liao, Chan-Yi 126, 139, 141
Lin, Chien-An 142
Lin, Chun-Yeon 61
Lin, Chyi-Yeu 105
Lin, D.W. 54
Lin, Jiong-Wei 105
Lin, Ming-Che 87
Lin, Pin-Cheng 92

Lin, Po Ting.....	99, 103, 104, 105, 118, 143
Lin, Shang-Chih	65
Lin, Tzu-Chun	94
Lin, Yi-Ying.....	147
Lin, Yu-Cheng.....	88
Lin, Yu-Hsuan.....	87
Lin, Yung-Chiang.....	63
Liu, Chii Hong.....	104
Liu, Chin-Ho	65
Liu, Zhe-Rui	142

M

Mahesh	63
Mufarrih, AM.....	103

N

Nakade, Rohan Kishor	106
Nuha, Aufa Ulin	64

O

Ochiai, Makoto.....	37
Ok, Suksan	144

P

Pan, Lin-Shang	104
Pandey, Gaurav	49
Park, Jiwon.....	66, 95
Park, Jonghwan	45, 66, 95, 144
Pei, Kuang-Chih	54
Peng, Peng-Chi.....	56
Prasad, Sneha	63, 106
Pyun, Do-Kyung.....	45, 66, 95, 144

R

Rai, Paaesee.....	106
-------------------	-----

S

Shen, Kun-Huai.....	102
Shiu, Yaw-Hwa	54
Shyu, Hung-Fa	54
Su, Shun-Feng	65
Su, Wei-Hung.....	94
Su, Yung-Shun	52
Sze, Jyh-Rou.....	88

T

Tong, Pao-Hung	47, 154
Tong, Pei-Gang	89
Tsai, Hsing-Hsien.....	144
Tsai, Jung-Ting.....	64
Tsai, Yue-Jhe.....	149
Tsao, Chia-Wen.....	91
Tseng, Yi-Chuan	99
Tseng, Yin-Jui	64
Tu, Han-Yen.....	93, 101

W

Wang, Cheng-Feng.....	87
Wang, Jen-Chieh	49
Wang, Yun-Hsuan.....	58, 108

Wei, An-Chi.....	88
Wei, Kuang-Hung.....	58, 108
Weng, Jing-Feng.....	62
Wong, Wei-Cheng	149
Wu, Ching-Fa	105
Wu, Po-Yu	90
Wu, Wen-Chua	111, 112, 151
Wu, Zong-Jun	87

Y

Yang, Che-An	146
Yang, Che-Hua	43, 69, 82, 119, 120
Yang, Chen-Fei.....	99
Yin, Ching-Chung	43, 60, 67, 111, 112
Yoon, Sungmin.....	94
Yu, Shang-Pang	89

Z

Zhang, Dun-Ning.....	111
----------------------	-----

丁

丁郁宏	83
-----------	----

何

何昭慶	114
何青原	129

余

余國禎	123, 125
-----------	----------

余

余坤城	76
余業緯	76
余金賢	56

劉

劉建宏	115
劉有晟	127
劉松明	56
劉警文	121

古

古運承	125
-----------	-----

吳

吳亦莊	70
吳啓守	76
吳峻傑	56
吳紹琪	122
吳維勁	125
吳育仁	68
吳郁君	122

呂

呂文豐	130, 132, 133, 134
-----------	--------------------

周

周品好.....	113
周彥廷.....	114

姬

姬俊宇.....	56
----------	----

孫

孫千茹.....	75
孫慶成.....	76

宋

宋泓慶.....	124
----------	-----

康

康皓宇.....	117
----------	-----

廖

廖偉丞.....	138
廖昭仰.....	121
廖柏宇.....	82
廖駿偉.....	125

張

張啓瑞.....	122
張紋綺.....	81
張家源.....	115
張昀萱.....	138
張瑋翔.....	68

戴

戴棟文.....	80
----------	----

施

施宥恩.....	83
----------	----

曾

曾偉智.....	121
曾科毓.....	136

朱

朱民宏.....	123, 125
----------	----------

李

李任翔.....	152
李尚樺.....	123
李建洲.....	133
李志杰.....	124
李文献.....	134
李明安.....	118
李維哲.....	70
李維楨.....	113
李育緯.....	120

杜

杜權家.....	124
----------	-----

林

林俊佑.....	81
林冠廷.....	129
林凱芸.....	67
林士瑄.....	79
林士罡.....	76
林宏儒.....	79
林庭寬.....	71
林建凱.....	123, 125
林榮讚.....	122
林皇辰.....	70
林育廷.....	126
林育志.....	128
林財得.....	135
林錦德.....	117

柯

柯昱宏.....	77, 84
----------	--------

柳

柳彥祺.....	135
----------	-----

梁

梁育翔.....	118
----------	-----

楊

楊宗勳.....	76
楊智詠.....	153
楊曼岑.....	116
楊程軒.....	121

歐

歐家安.....	81
----------	----

沈

沈志雄.....	80, 81, 116
沈立宗.....	80

洪

洪嘉鍵.....	138
洪敬傑.....	84
洪裕涵.....	71

溫

溫博浚.....	118, 137
----------	----------

王

王俊傑.....	123
王睿謙.....	69
王祥瑋.....	83

田

田春林..... 77, 84

盧

盧光輝..... 118

翁

翁德富..... 84

翁珮旋..... 127

范

范潤洋..... 117

莊

莊國志..... 128

葉

葉俊平..... 78

葉嘉興..... 78

葉祐良..... 82

葉雲鵬..... 82

董

董曉明..... 78

蔡

蔡坤釗..... 78, 130, 134

蔡官邑..... 119

蔡建安..... 124

蔡武哲..... 79

蕭

蕭力瑋..... 76

蕭天文..... 151

蕭涵翊..... 137

蘇

蘇于琪..... 127

蘇兩傳..... 152

蘇彥宇..... 120

蘇暉凱..... 121

蘇詠靖..... 114

袁

袁翊峻..... 76

許

許家逢..... 135

許建核..... 70

謝

謝佳妤..... 80

謝焱瀚..... 131

謝睿祺..... 128

邱

邱政斌..... 117

邱柏誠..... 153

邱雍惟..... 136

郭

郭佳揚..... 154

郭榆承..... 136

郭瀚聲..... 129

郭育誠..... 82

郭金龍..... 74

郭韋凡..... 74

鄭

鄭偉凡..... 74

鄭年添..... 83

鄭銘文..... 73

金

金大仁..... 121

鍾

鍾明雄..... 78

阮

阮光鈞..... 76

陳

陳世峯..... 151

陳偉譯..... 74

陳冠霖..... 128

陳勁豪..... 83

陳又維..... 137

陳夏宗..... 83

陳奕成..... 73

陳建穎..... 69

陳明書..... 76

陳昕..... 124

陳漢昕..... 123, 125

陳煜琦..... 136

陳玉彬..... 117

陳秀易..... 78

陳豪韋..... 152

陳雨玟..... 75

雍

雍敦元..... 134

顏

顏汝珊..... 71

馮

馮聖皓..... 128

高

高全盛..... 75, 79

黃

黃丞頤..... 138

黃伯揚..... 74

黃宇綻..... 119

黃建勝..... 83

黃啟貞..... 136, 154

黃翌宸..... 77, 84

黃鈺晶..... 68

黃鴻鈞..... 79

黎

黎家銘..... 74, 136



財團法人台灣非破壞檢測協會
The Society for Nondestructive Testing
& Certification of Taiwan (SNTCT)



國立中央大學
National Central University