

14th International Conference on Compressors and their Systems

Emerging technologies in Compressors and their Systems

8th – 10th September 2025

City St George's, University of London

POST CONFERENCE REPORT

Background

The International Conference on Compressors and their Systems series began in 1999 as a result of industrial consultation and need for academic collaboration. At the time the conference was organised by the Fluid Machinery Group of the Institution of Mechanical Engineers (IMechE). In 2009 the Centre for Compressor Technology at City, University of London took over its management and the Conference is now one of the main conventions, taking place biennially in the UK, becoming world-renowned for its place in the industry and academia to gather and discuss a broad range of topical issues related to compressors and compression systems. IMechE remains a longstanding partner, along with the International Institute of Refrigeration (IIR), and the Institute of Refrigeration (IOR). This year's Conference was additionally supported by the following organisations:

- The Manufacturing Technologies Association (MTA)
- British Compressed Air Society (BCAS)
- Machines, an Open Access Journal from MDPI
- European Forum for Reciprocating Compressors (EFRC)
- The Academy of Sciences and Arts of Bosnia and Herzegovina (ANUBiH)
- Lightyear Foundation, charity for disabled and neurodivergent children and young people taking part in STEM

The Conference has three Committees:

1. Organising Committee
2. International Liaison Committee
3. Programme and Scientific Review Committee

The Conference is chaired by Prof Ahmed Kovacevic and Ms Ivona Ivkovic-Kihic, steered and organised by the Organising Committee which consists of staff from the Centre for Compressor Technology, events team at City St George's, University of London, senior representatives from partner institutes and representatives of the Platinum and Gold sponsors.

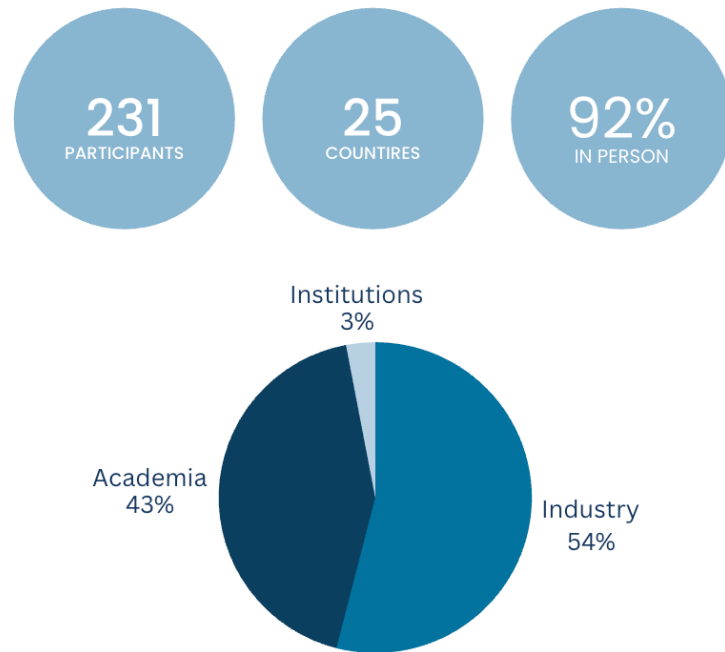


The International Liaison Committee is a consortium of eminent members from industry and academia who principally advise the organising committee on trends and topics in the compression industry which would be of interest to the conference delegates. They also promote the conference in their parts of the world.

The Programme and Scientific Review Committee, chaired by Dr Matthew Read, is integral to the conference. Its function is to ensure an outstanding programme and the highest quality of research papers presented at the Conference.

Since 2012, the main conference has been preceded by a two-day Short Course and Forum on CFD in rotary positive displacement machines, led by Dr Sham Rane.

Summary



The 14th Conference in the series was held from 8th to 10th September as a hybrid event, delivered in person at City St George's, University of London, United Kingdom, and streamed online via event platform Eventee. It attracted 231 registered delegates from across the world representing variety of sectors.

The conference was officially opened by Professor Sir Anthony Finkelstein, FRS, FREng, President of the University, who welcomed delegates and emphasized the Conference's continued importance in shaping the future of compressor innovation and strengthening collaboration between academia and industry. Designed as a dynamic forum for knowledge exchange, the event once again provided a platform for academics, researchers, students, and

professionals to share the latest scientific findings, technical developments, and best practices across the compressor field.

The 2025 Conference featured three keynote presentations, two panel sessions, and a comprehensive programme of parallel technical sessions covering a wide range of topics, including:

- Screw Compressors
- Reciprocating Compressors
- Scroll Compressors
- Novel Compressors and Applications
- Heat Pumps,

as well as Compressor Systems, Numerical and experimental modelling, analysis, and testing, Expanders, Lubrication, Vane Compressor Types, Measurements, Valves, Operations and Turbomachinery.



Conference delegates had an opportunity to mingle around the venue, socialize, share experiences, and explore posters on other research topics.

The Organising Committee of the Conference is grateful for the support provided by our partners to deliver the 2025 Conference and for the financial assistance provided by our sponsors.

Proceedings of the 14th International Conference on Compressors and their Systems are published by Springer in Proceedings in Energy.

Technical Program Highlights

84 technical papers covering a wide range of topics were accepted for presentation during the 14th International Conference on Compressors and their Systems. Papers were presented in 15 topic areas across 24 technical sessions. Highlights from some of these sessions are summarised below. The conference proceedings published in the renowned Springer Proceedings in Energy include 81 of these papers. There were 23 papers submitted and presented by students.

Screw Compressors

Screw Compressors were covered in four sessions, with topics including performance modelling approaches, rotor thermal deformation and conjugate heat transfer analysis, the influence of discharge noise suppression, analysis of tribological effects and the influence of clearance distribution. Studies of machine designs for refrigeration and heat pump application were also presented, including an investigation of the dynamics of a high-speed screw spindle compressor.

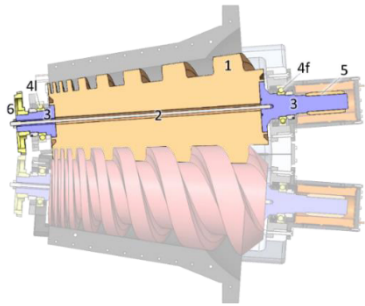


Figure 1: Screw spindle compressor assembly

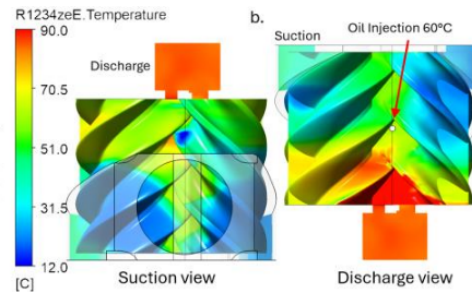


Figure 2: Temperature in refrigeration compressor

Reciprocating Compressors

Presentations relating to reciprocating compressors covered the influence of coolant and vapour injection, flow-structure interactions and stress analysis in

diaphragm compressors, modelling of compressors in vehicle air suspension systems, and design consideration for PMSM motor types.

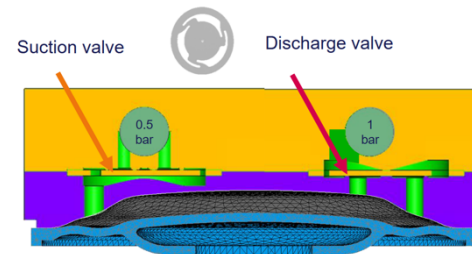


Figure 3: Diaphragm compressor simulation

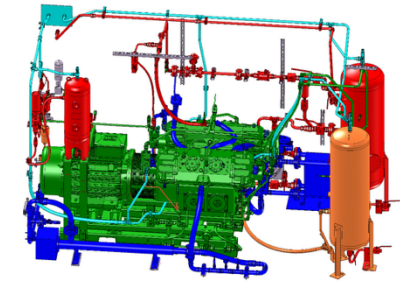


Figure 4: sCO₂ reciprocating compressor system

Scroll Compressors

A number of scroll compressor studies were presented across two sessions. This included studies investigating asymmetric scroll wraps with variable thickness, a single-spiral co-rotating configuration, multi-physics modelling relating deformation, bearing loads and leakage, and integration of high-speed electric drives.

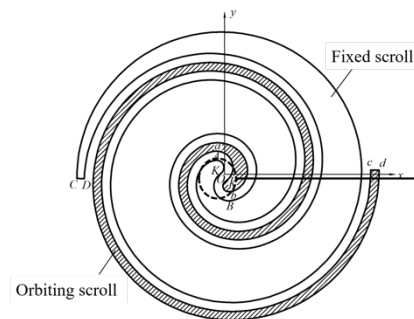


Figure 5: Variable thickness scroll geometry

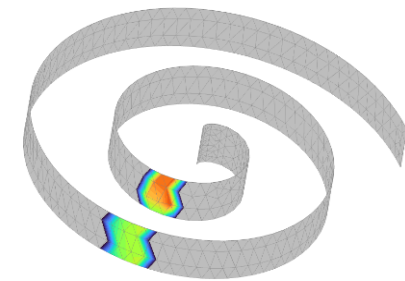


Figure 6: Modelling for leakage prediction

Novel Compressors and Applications

Sessions on novel compressor and applications included discussion of the use of deep neural networks for profile generation, surface structures to reduce leakage, the challenges and opportunities for supercritical CO₂ and liquid hydrogen applications, sealing technology for Wankel type compressors, and an investigation of isothermal compressor and expansion via liquid injection.

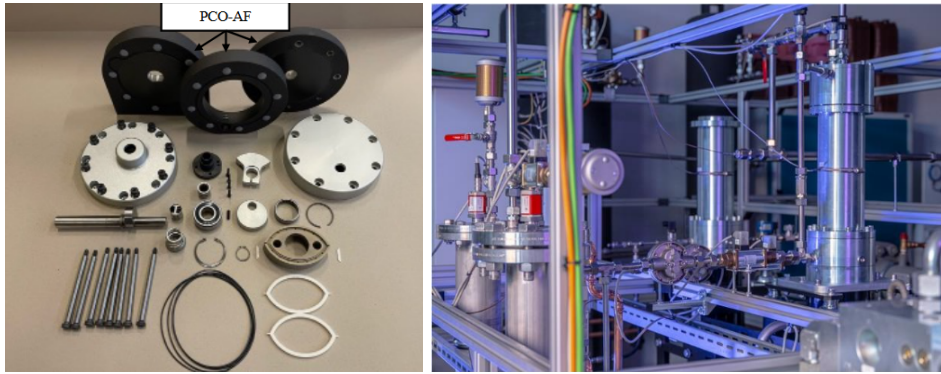


Figure 7: Prototype Wankel compressor Figure 8: Liquid injection compressor test bench

Heat Pumps

A number of heat pump studies were presented focussing on exergy and performance analysis for operation in a range of climates and using a range of hydrocarbons and low GWP refrigerants. A single stage thermal compressor driven heat pump, and two-stage systems to enhance the operating envelope were discussed, along with compressor selection for industrial applications.

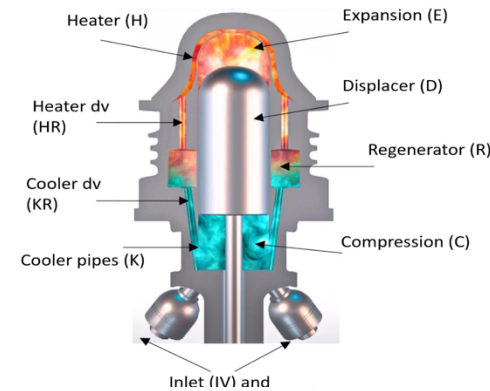


Figure 9 Thermal compressor heat pump

Other topics that were presented across a range of sessions including; Compressor Systems, Numerical and experimental modelling, analysis, and testing, Expanders, Lubrication, Vane Compressor Types, Measurements, Valves, Operations and Turbomachinery. Highlights from these sessions included studies on the numerical analysis of conjugate heat transfer and tip leakage flows in roots blowers, and the measurement and modelling of refrigerant properties and the influence on gap flows.

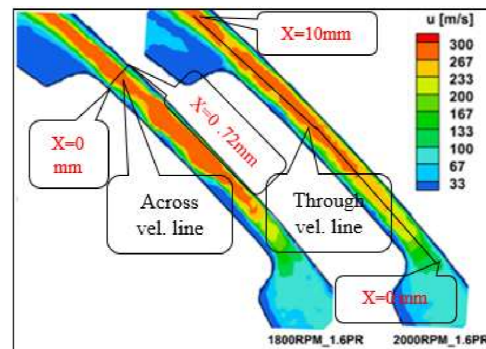


Figure 10 Leakage flow analysis in roots blower

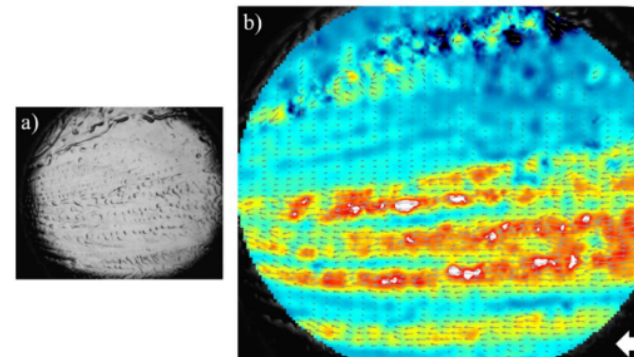


Figure 11 Optical velocity measurements of oil-refrigerant mixture

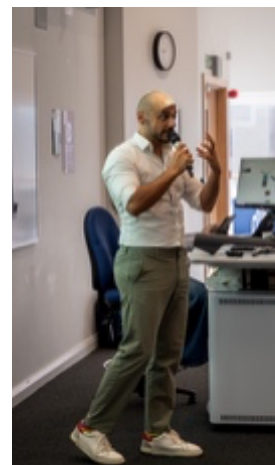
Keynote talks, Panel discussions and Industry talks

The program of the 14th International Conference on Compressors and their Systems was diverse this year, featuring three keynote talks and two panel discussions, as well as five industry talks.

Keynotes



Prof. Dr.-Ing. Robin Langebach from Karlsruhe University of Applied Sciences delivered an engaging presentation titled “An example-orientated discussion about somewhat unusual research projects in the field of compressors and refrigeration technology.” His talk showcased a range of innovative, project-based research topics — from the development of new sensors and high-pressure liquid injection techniques to the application of Augmented and Virtual Reality in teaching and research — offering fresh insights and inspiring perspectives for future advancements in the field.



Dr Marco Pietropaoli, CEO and Co-Founder of ToffeeX, gave a talk on “A New Physics-Based Design Framework for High-Performance Fluid Components”, which introduced a new generative design approach for high-performance thermofluid components using advanced multi-physics simulation. He showed how the ToffeeX platform enables engineers to optimise compressors, turbomachinery, and thermal systems in hours rather than months, while keeping manufacturability in focus. The keynote highlighted how these tools provide faster, production-ready designs and greater transparency, helping engineers overcome the traditional “black box” challenge in optimisation.



On the third day, **Prof David Pearson** from Star Refrigeration gave a talk on the topic of “Possible Future Opportunities in Compressor and System Design Relating to Industrial Heating – A Customer Perspective”. David shared a customer-focused view on how compressor and system design can evolve to support industrial heating in a changing energy landscape. Drawing on decades of practical experience, he highlighted the importance of sustainability, durability, and empathy in design—calling for compressors that last longer, need less maintenance, and operate oil-free where possible. He discussed opportunities in multi-stage compression, faster start-up systems, and improving efficiency through better system operation. The talk concluded with a message to future engineers to stay connected to customer needs and adapt designs to meet new market and environmental challenges.



Dr-Eng. Yosr Allouche gave a dinner speech at the Conference Gala Dinner. Dr Allouche is the General Director of the International Institute of Refrigeration since October 2024. Dr Allouche holds a PhD in Mechanical Engineering and stood out as a research scientist in refrigeration technology at the Norwegian University of Science and Technology (NTNU) where she is also performing as an Associate Professor in Refrigeration since 2021. In her talk, Dr Allouche outlined the fact that refrigeration air conditioning and heat pumps use 20% of electrical energy generated worldwide and that percentage as well as the scale of these technologies will increase in the next decades. In her talk she focused on the importance of applying environmental friendly refrigerants and integrated thermal storage systems using phase change materials.

Panel discussions



Panel Session 1: Digital Evolution in Compressor Systems

Chaired by Dr. Billy Milligan (Howden, Chart Industries Company), this thought-provoking panel explored how digitalization is reshaping the compressor industry across its entire lifecycle—from design and manufacturing to maintenance and end-of-life management. The discussion, featuring Professor Robin Langebach (Karlsruhe University of Applied Sciences), Jan Hemper (InControl & AssetMinder), and Halil Lacevic (City St George's, University of London), delved into the growing role of artificial intelligence in predictive maintenance and autonomous diagnostics, as well as the challenges of integrating smart sensors and data analytics into legacy systems. The panellists also addressed the importance of ensuring data accuracy and actionability to enhance performance and energy efficiency. The session concluded with a lively Q&A, where audience members raised insightful questions on topics such as the implications of the European Data Act and Cyber Resilience Act, the types of sensors required for predictive maintenance, the potential for leasing compressor systems similar to aircraft engines, and the integration of health monitoring software into compressor products.



Panel Session 2: How Are New Technologies Reshaping Engineering Studies

Chaired by Sami Tuffaha (Combitherm GmbH and TU Dresden), this engaging session explored how emerging technologies—from artificial intelligence and simulation to 3D printing and digital collaboration tools—are redefining the way engineers are educated and prepared for the future. The panel brought together diverse perspectives from academia and industry, including Dr. Thibaud Plantegenet (University of Poitiers), Fabian Luther (Chemnitz University of Technology), Samuele Beltrametti (Politecnico di Milano), and Lukas Dur (Graz University of Technology). Discussions focused on the evolving skill sets required of future engineers, how university curricula are adapting to technological change, and the role of industry in bridging the gap between education and practice. The audience contributed actively with questions about the use of AI in preparing research, balancing hands-on experience with digital learning, and the environmental impact of AI technologies. Other topics included the competition between academia and industry for digitally skilled students, the potential job displacement caused by AI, and the transformative possibilities of quantum computing, augmented and virtual reality.

Partners, Sponsors and Exhibitors



The 14th International Conference on Compressors and their Systems was sponsored by ten international, world-renowned companies. Traditionally, the platinum sponsor was PTG – Holroyd and the Gold Sponsor was Howden, a Chart Industries Company. Mayekawa sponsored the Gala Dinner at Horizon 22. Silver sponsors were PDM Analysis Ltd, Jaacklin GmbH, Kapp Niles, Daikin and Intec Rotors. Student awards were sponsored by Gamma Technologies, while Aerzen sponsored the social event.

Additionally, Conference hosted three exhibitors: Convergent Science, Gamma Technologies and Simerics.

The Gala Dinner at Horizon 22 offered delegates a memorable evening at London's highest event venue, with stunning panoramic views of the city. The evening featured speeches from the Ambassador of Bosnia and Herzegovina to the UK, Mr Osman Topcagic, Dr-Eng. Yosr Allouche, Director General of the International Institute of Refrigeration and other distinguished guests. The dinner also marked the 30th Anniversary of the Centre for Compressor Technology.

The Centre for Compressor Technology also sponsored a guided London walking tour with University students, giving attendees the chance to explore historic landmarks while engaging in informal discussions and enjoying the city's cultural highlights.



As part of its commitment to inclusion and accessibility, the Centre for Compressor Technology sponsored four disabled and neurodivergent students to attend the conference, in partnership with the Lightyear Foundation. This initiative aimed to provide equal opportunities for all students to engage with cutting-edge research, connect with industry professionals, and gain first-hand experience of an international scientific event. The collaboration with Lightyear Foundation reflects the Centre's ongoing dedication to supporting diversity and widening participation in engineering and science.

AWARDS

Best Paper Award + £350

Analysis of a R1234ze(E) Twin Screw Compressor using Thermodynamic Chamber and 3D CFD Models

Sham Rane, Ahmed Kovačević, Nikola Stošić
City St George's, University of London, United Kingdom

Best Student Paper Award + £350

Operation Characteristics of a Prototype Vapor-injected Reciprocating Compressor for Use in a Multi-Evaporator Domestic Refrigerator/Freezer

Changkuan Liang, Davide Ziviani, James E. Braun, Eckhard A. Groll
Ray W. Herrick Laboratories, Purdue University Mechanical Engineering West Lafayette, IN, USA

Best Student Presentation Award + £350

Structural Dynamics and Resonance Avoidance in High-Speed Spindle Screw Compressors

Sami Tuffaha^{1,2}, Konrad Klotsche¹, Christiane Thomas¹, Ullrich Hesse²

1: Technische Universität Dresden, Germany;

2: Combitherm GmbH

7th Short Course and Forum

Emerging Technologies for CFD in Rotary Positive Displacement Machines



This year, the Centre for Compressor Technology organised its seventh short course on Emerging Technologies for CFD in Positive Displacement Machines (PDM). The course and forum were held before the conference, on 6th-7th September 2025 at City St George's, University of London campus as an in-person only event. 36 delegates from 8 countries were present and the course delivered 16 lecturers, 11 from academia and 5 from industry.

This seventh event in the series was dedicated to Emerging Technologies and advanced topics in the application of chamber models, 3D CFD and experimental techniques in PDM such as:

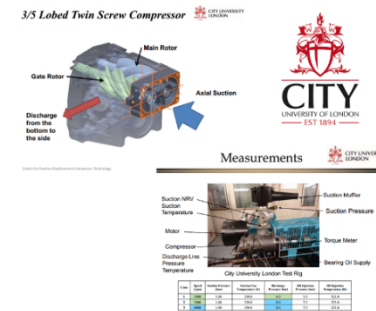
- Applicability of new methods such as Machine Learning, Artificial Intelligence, AR/VR, Lattice Boltzmann Method, Smoothed particle hydrodynamics, Mesh free algorithms, Digital Twins and Quantum Computing.
- Advances in grid generation, CFD tools, Open source CFD solvers and new techniques for PD machine analysis.
- Advances in lower order modelling techniques, FSI applications and hybrid 1D – 3D CFD coupled approaches.

- Modelling leakage flows, conjugate heat transfer, stability and accuracy of multiphase flow calculations and Multiphysics approach.
- Experimental techniques for analysis of PDM.

These subjects were supported by provision of test data for twin-screw dry air and oil injected air compressor provided by the Centre for Compressor Technology, a single-screw expander test data provided by Purdue University and an ORC Vane expander test data provided by University of L'Aquila. Presenters on the course used these test cases to demonstrate new CFD techniques and validate their findings.

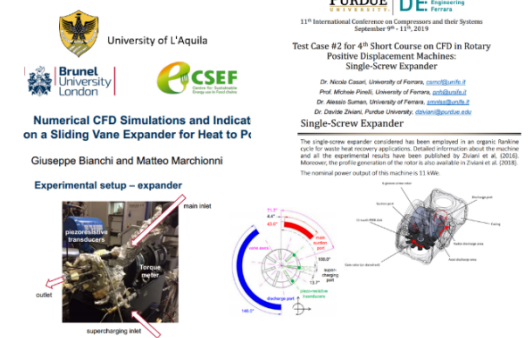
Short Course – Test Cases

Test Case 1 – Dry Air Twin Screw Compressor



Test Case 3 – Oil Injected Air Twin Screw Compressor

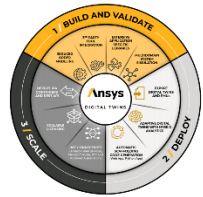
Test Case 2 – Single Screw Expander



Test Case 4 – ORC Vane Expander

A special section of the short course this year was dedicated to Quantum Computing and Lattice Boltzmann Methods (LBM). On 7th September, Sunday, A keynote talk was delivered on High Performance CFD, encompassing the subject of HPC, AI and Quantum Computing by Intelligent Simulations Ltd. This was followed by a set of three lectures. First on the LBM formulation and

its current state-of-art for engineering applications by University of Manchester, followed by the basics of Quantum Computing in solution of non-linear partial differential systems by City St George's, University of London. The third lecture from TU Delft then combined these topics and presented Quantum LBM aspects, limitations and applications.

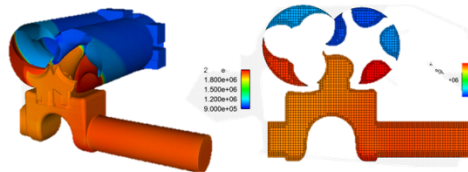


Ansys



Mr Bill Holmes

Digital Twin and CFD



From HPC to AI to Quantum Computing:
The Ongoing Pursuit of High-Performance
CFD

Anthony Massobrio

Sunday 7th September 2025



Talks this year saw an increase in the use of machine learning and digital twin aspects too. Introduction session on Day 1 focused on fundamentals of CFD implementation using Finite-Volume Method specifically for moving, deforming domains and the associated solver features. City research works such as Project SECRET and Industrial Consortium CERES were presented. Following this, novel research in the area of CFD in rotary positive displacement machines were presented over two days of the course. Subjects such as full 3D analysis of oil flooded refrigeration compressors, scroll machines, quantitative comparison of CFD results with test data, Bi-directional system coupling for gap variation, Conjugate heat transfer, new solvers such as ANSYS Forte,

OpenFOAM, fluid structure interaction and novel grid generation techniques, algebraic and differential grid generation, Multi-Phase flow modelling were examples of significant advancements in technology.

**GT-SUITE 1D and Quasi-3D approach for
detailed compressor modelling: physics
simulations empowered by ML**

**GAMMA
TECHNOLOGIES**

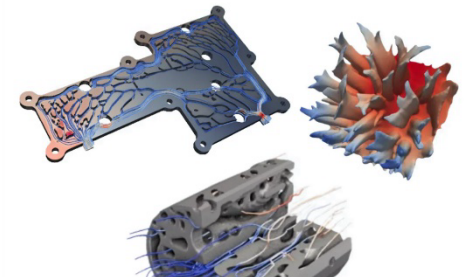


Dr. Matteo Luzzi

An integrated modelling approach such as SCORG and GT-Suite to combine the thermodynamic and fluid flow solution from chamber-system type of models also caught attention. Variety of rotary positive displacement machines presented ranged from the conventional twin-screw compressors to vane machines, single-screw machines, scroll machines as well as some non-conventional machines such as variable lead and variable profile or conical rotary machines. A new emerging technique of SplineMesh from TU Delft was presented with applications in twin screw machines.

ToffeeX - Physics-Driven Generative Design

ToffeeX



Nicola Casari

Some of the on-going research from Brunel University were introduced and a talk covering application of Internal Combustion Engine with Hydrogen fuel was presented. Forums and panel discussion were held on both the days of the course. Some of the research presented in the past Short Courses is published in



SAVE THE DATE

15th International Conference On Compressors and Their Systems 13-15 September 2027 | London, UK

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