

MAvRIC

Multi-Agent and Advanced
Robotics Centre

A DfE-funded HERC State-of-the-Art Teaching
and Research Facility

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Vice-Chair, IEEE UK and Ireland Control Systems Chapter

EPSRC ILN+ Researcher in Residence with Digital Catapult

20th October 2025



Main Centrepiece

- 2x ER-FLEX Systems
 - UR5e robotic arms mounted on MiR250 AGVs
 - Arm payload ≈ 5 kg
 - Vehicle payload ≈ 180 kg
 - Operation time up to 20 hours per day
 - Automation in manufacturing and digital twinning
 - Automate lab/hospital tasks to limit human presence and reduce risk of contamination
 - Home assistance



Main Centrepiece

- 1st HEI on Island of Ireland to utilise **Collaborative Robots (Cobot) + Autonomous Mobile Robots (AMRs) Combo** for Research and Teaching*



*As of June 2025

Key Equipment

- 4x Turtlebot4
 - Multi-sensor equipped AMRs
 - Max. payload $\approx$ 9 kg
 - Operation time: Up to 4 hours
 - LiDAR and depth camera



Key Equipment

- 3x Bambulab X1
 - Multi-Filament 3D Printers
 - 7 μ m LiDAR-assisted automatic calibration and inspection
 - CoreXY motion system
 - High-speed multicolor printing with AMS
 - Multi-material printing



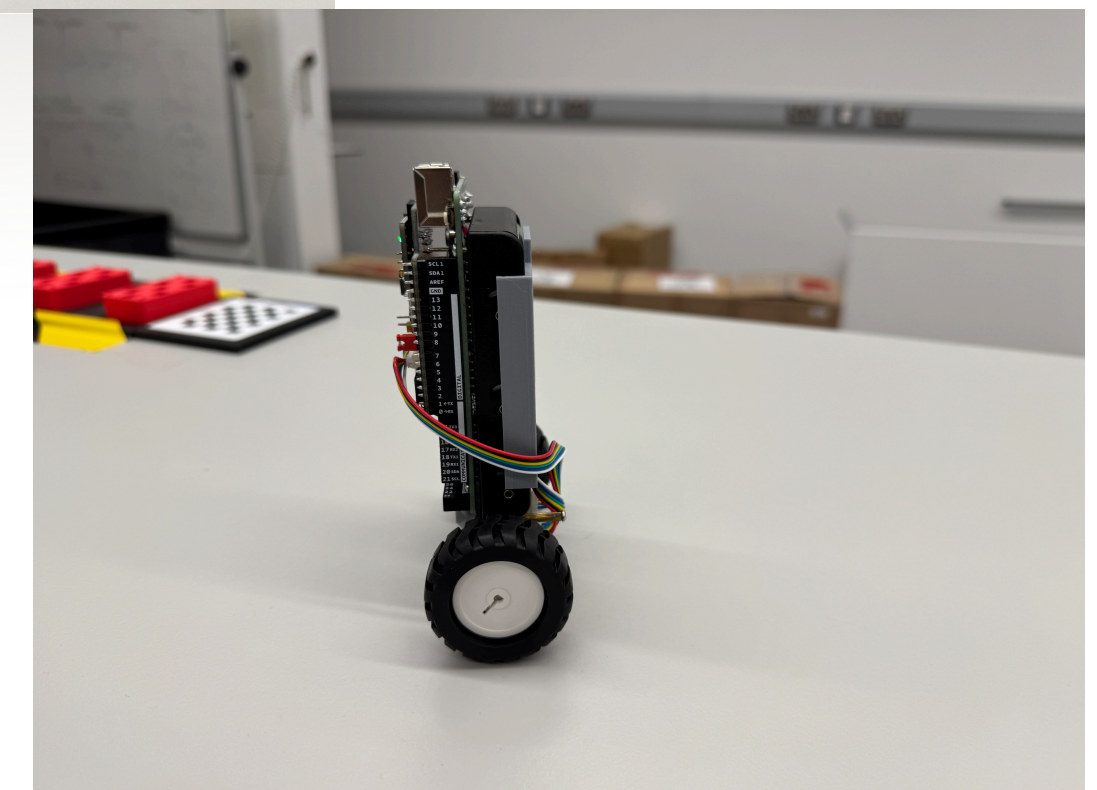
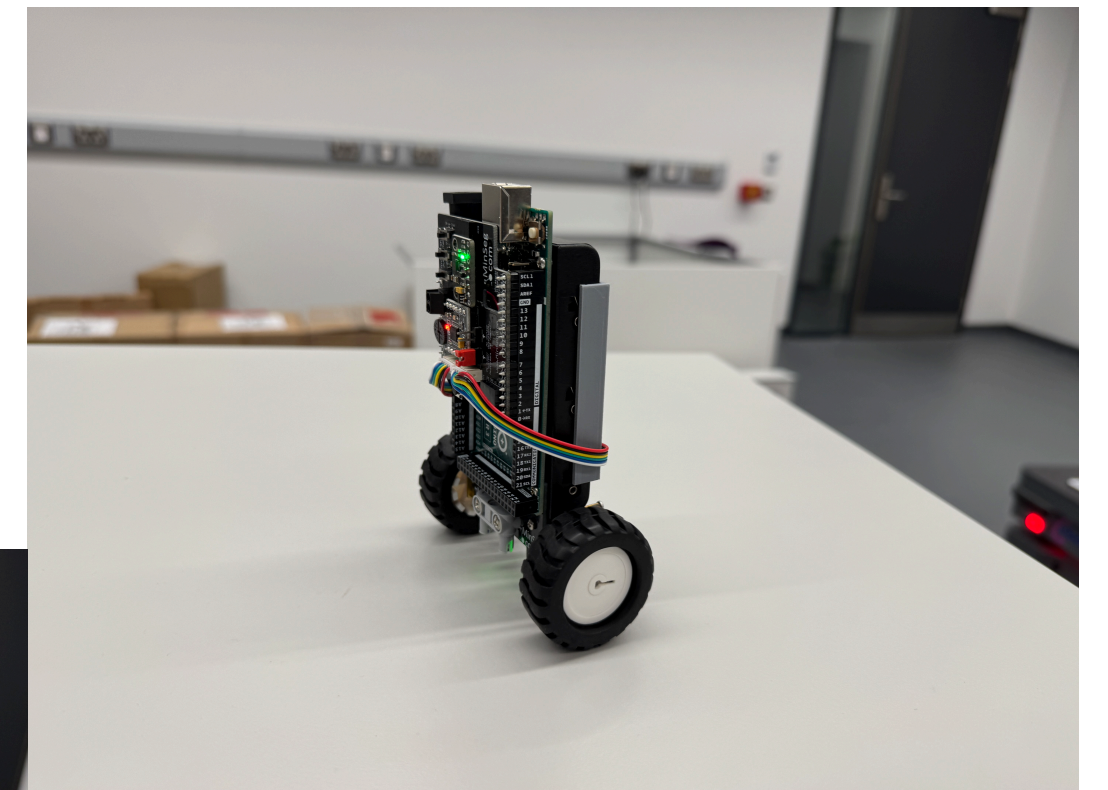
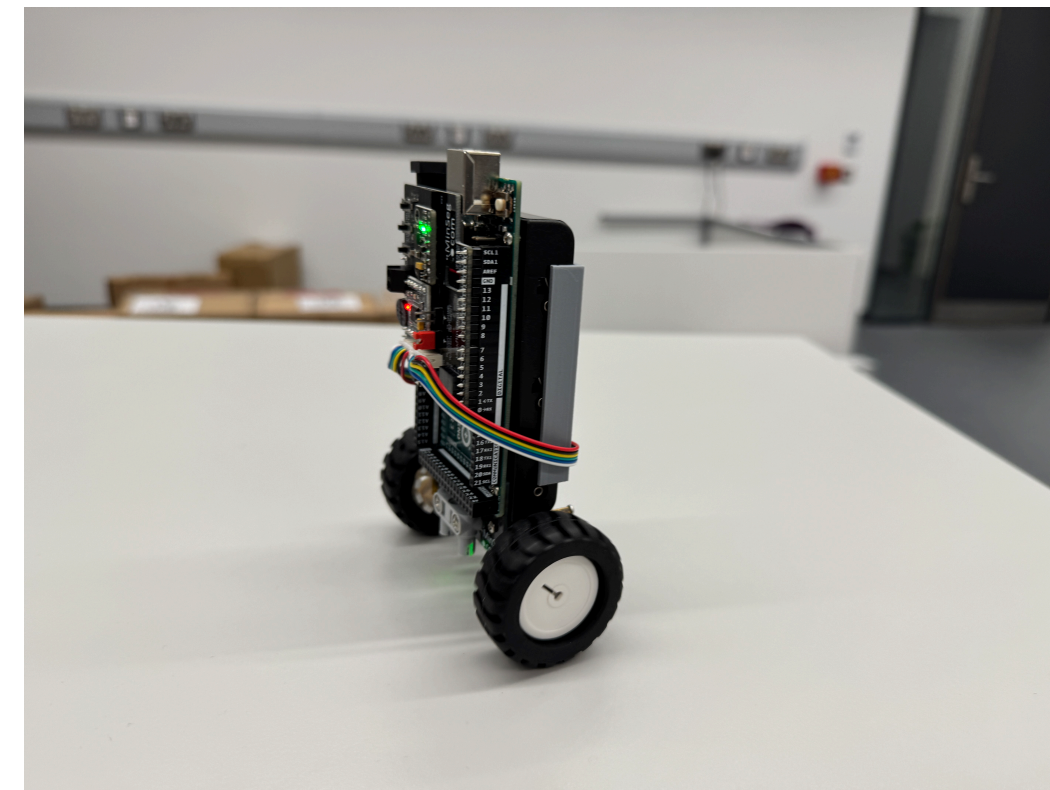
Key Equipment

- 3x OrangeApps Robotic Arms
 - Mini KUKA-Compatible Robotic Systems
 - KUKA® OfficeLite, the virtual robot controller from KUKA®
 - Gearbox and kinematics to mimic actual industrial robots



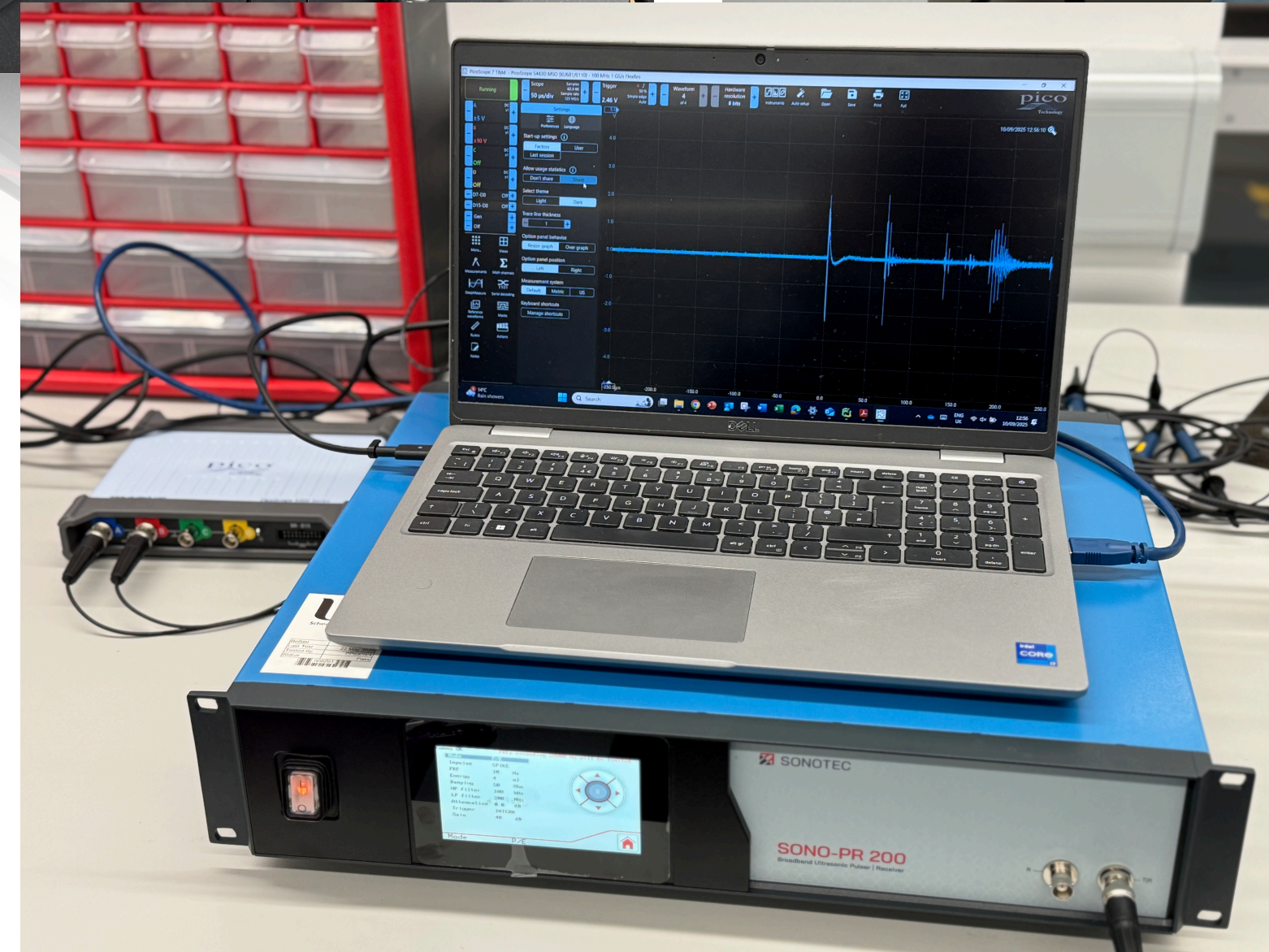
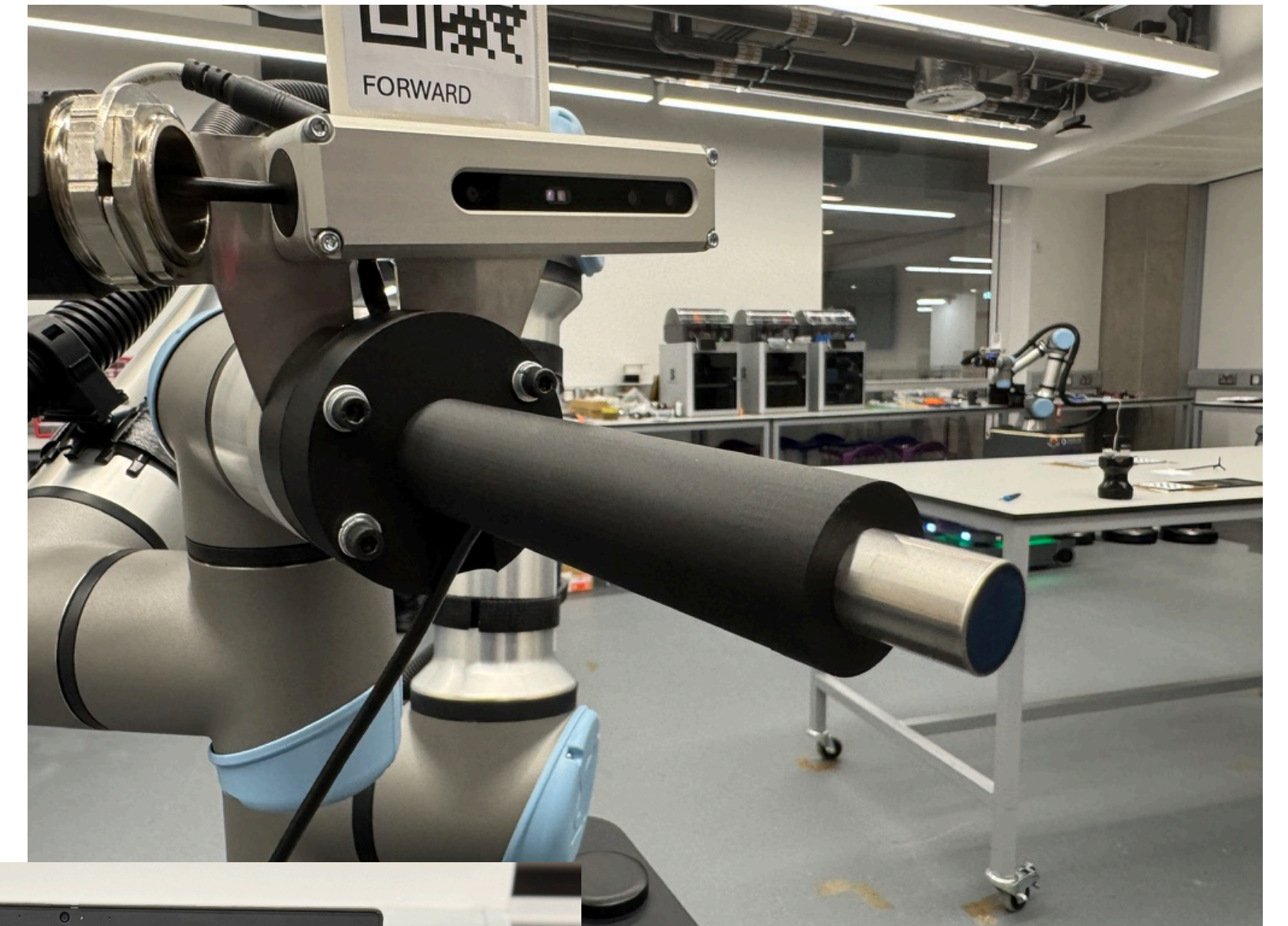
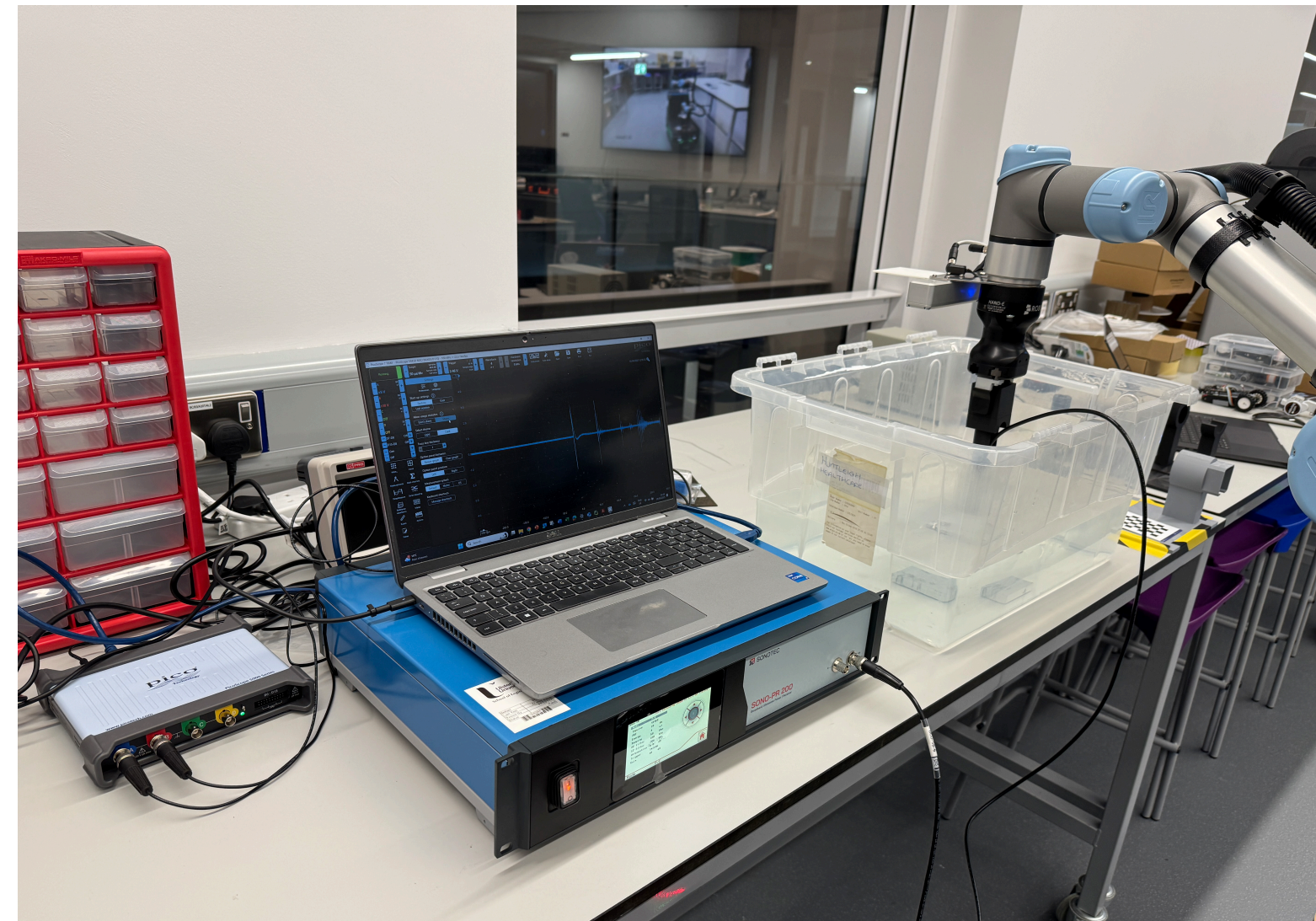
Key Equipment

- 4x MinSeg Robotic System
 - Multi-purpose advanced mini robots
 - Inverted pendulums — rockets, humanoids, etc.
 - Autonomous maneuverability
 - Real-time observation and control



Key Equipment

- Sonotec PR 200 Combi Pulser
- Picoscope 5443D Oscilloscope
- Ultrasonic immersion and contact transducers



Other Existing Equipment

- Festo CP LAB
 - 6x pallet transfer system
 - 4x system trainers
 - 2x CP Bridge
 - 1x Robotino + SIM Environment
 - 2x magazine modules
 - 1x measurement module
 - 1x muscle press module
 - 1x tunnel furnace module
 - 1x output module



Other Existing Equipment

- Inteco Control Systems
 - 1x helicopter system
 - 1x ABS braking system



Key Achievements Thus Far...

- Outreach activities
- Encourage STEM in NI and ROI
- Produce future talents and tech-equipped workforce
- UCAS Open Day 2025
- East Belfast Summer School 2025



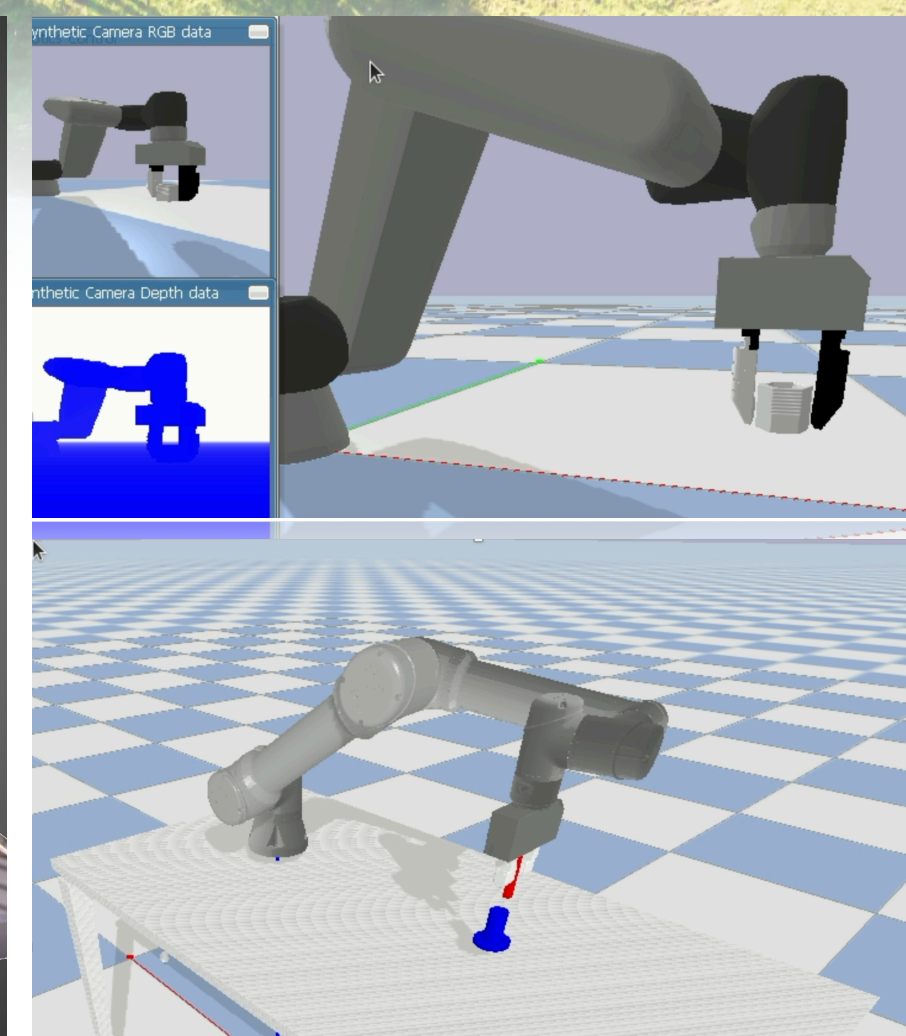
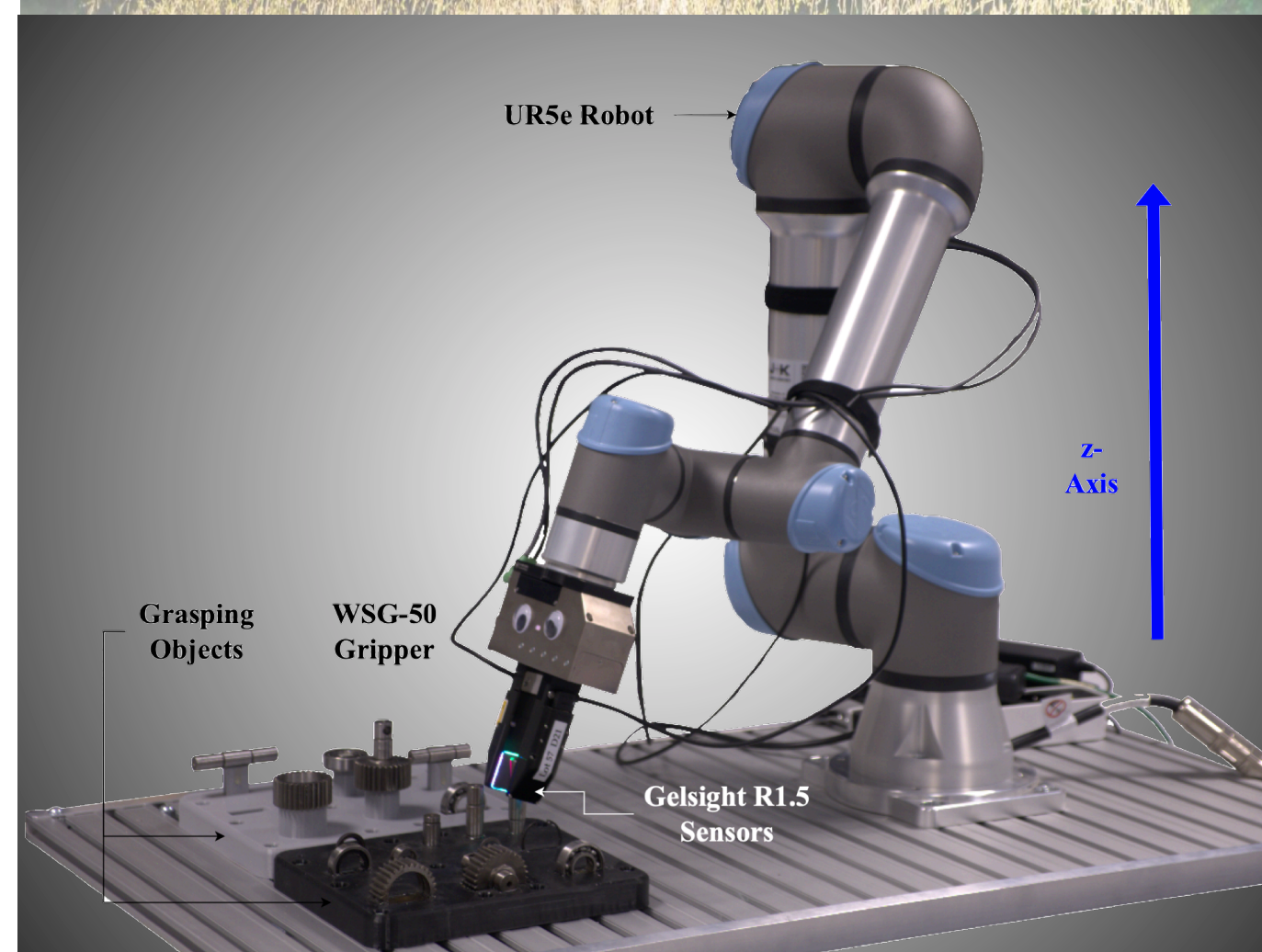
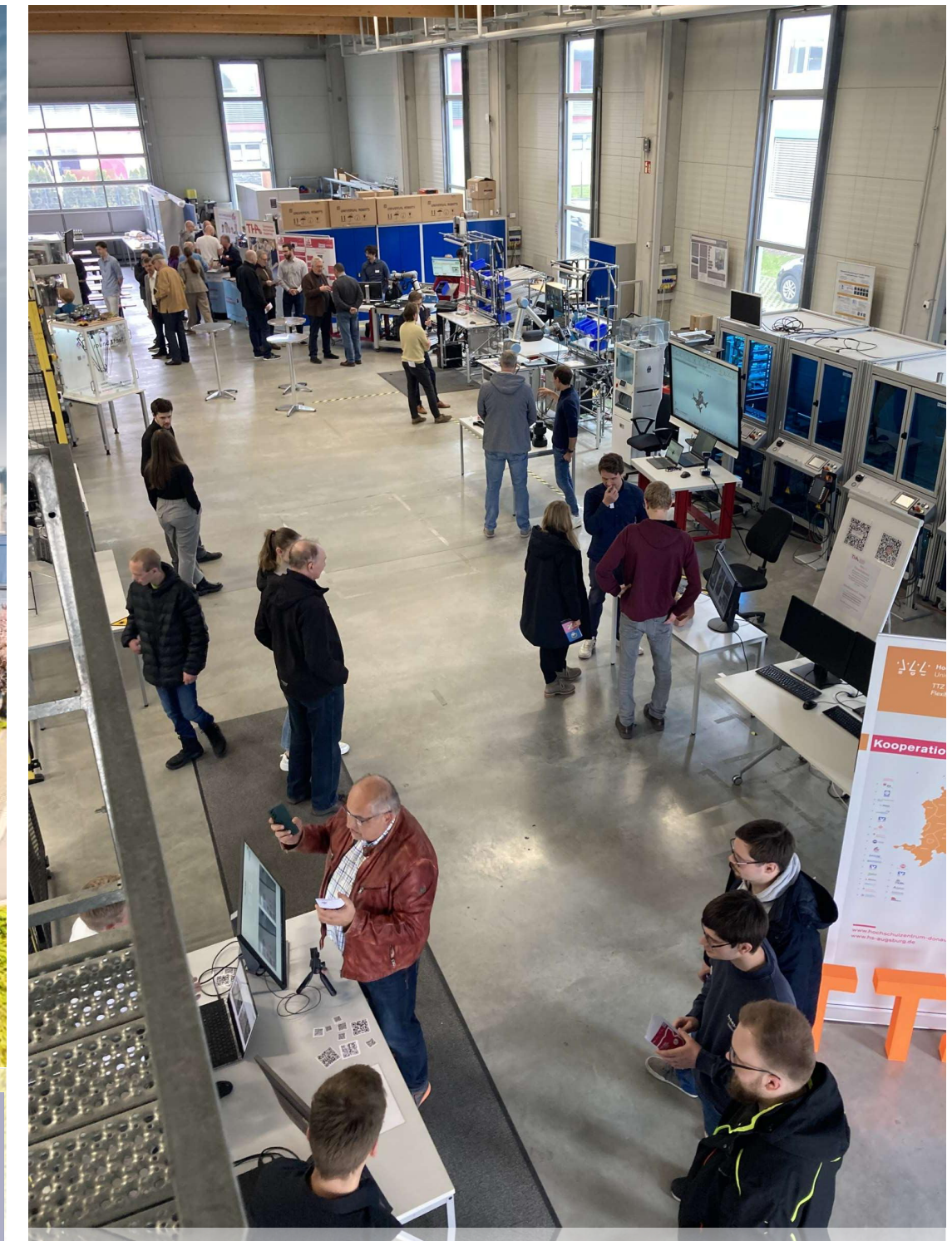
Key Achievements Thus Far...

- Hosted 2 exchange students via **EU Erasmus+ Traineeship Programme** (June–August 2025)



Key Achievements Thus Far...

- Further enhanced existing collaboration with **TTZ @ Nördlingen, Germany**
 - Joint PhD supervision
 - Multiple publications and organisation of conferences



Key Achievements Thus Far...

- **DfT** showcased and featured research from the lab at the **OECD Int. Transport Forum** (21–23 May 2025) as part of current UK research related to transport digital twinning

Digital Twin of a Turbocharged Spark-Ignited Engine System for Control and Fault Diagnosis

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Research Website

Physical Automotive Vehicle



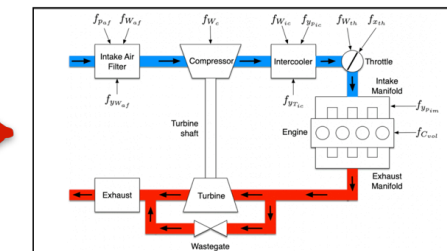
volvocars.com

Understanding of Engine Dynamics



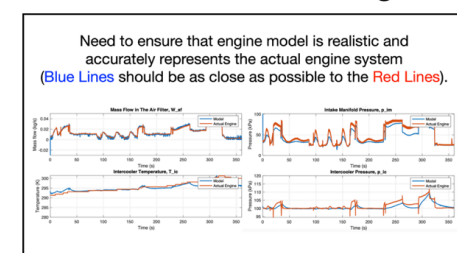
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Identifying Faults of Interest



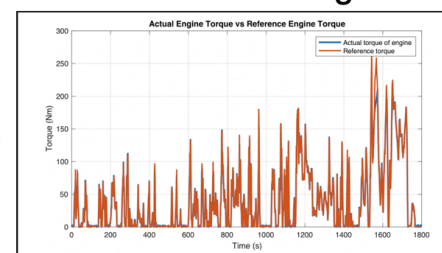
Ng et al., IEEE CSM, 2020.

Verification of Engine Model and Controller Design



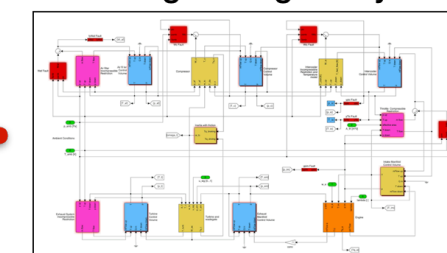
Ng et al., IEEE CSM, 2020.

Controller Design

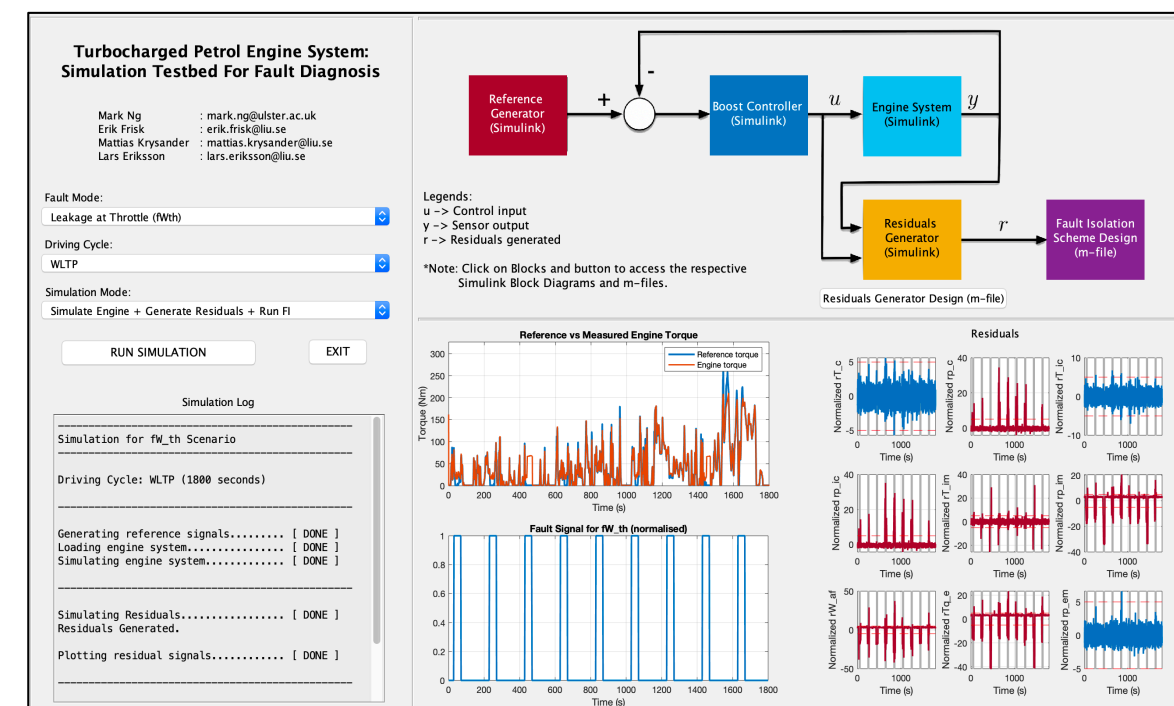


Ng et al., IEEE CSM, 2020.

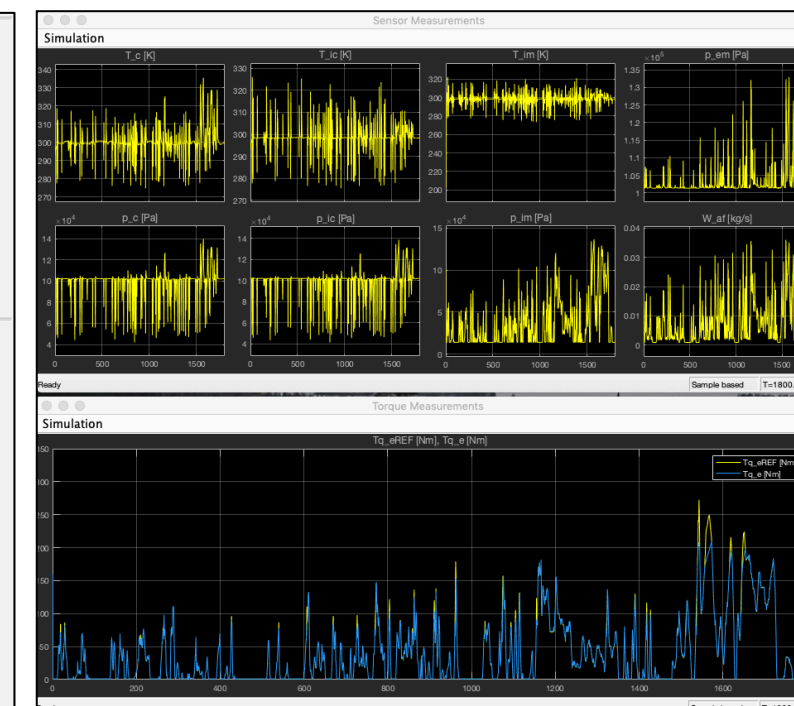
Modeling of Engine System



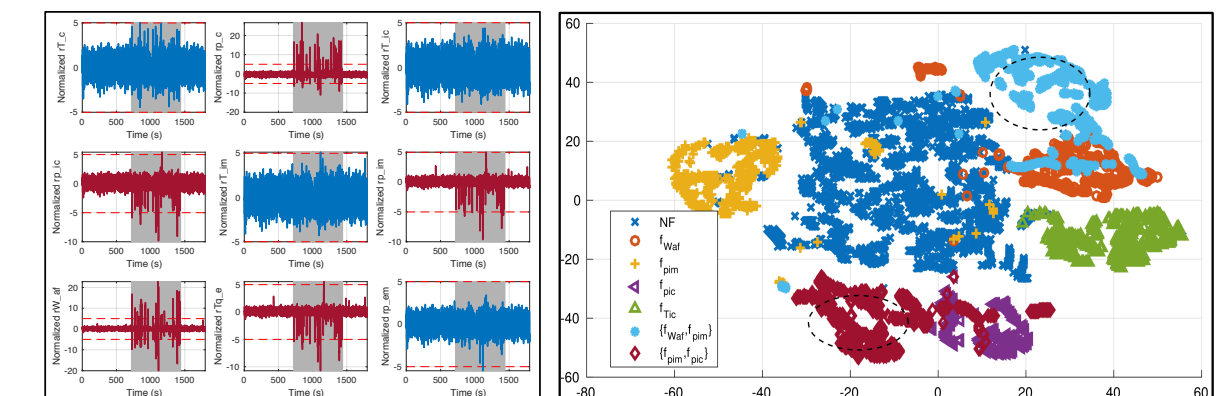
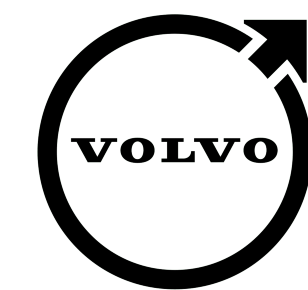
Ng et al., IEEE CSM, 2020.



Simulation GUI and Telemetry Visualizations

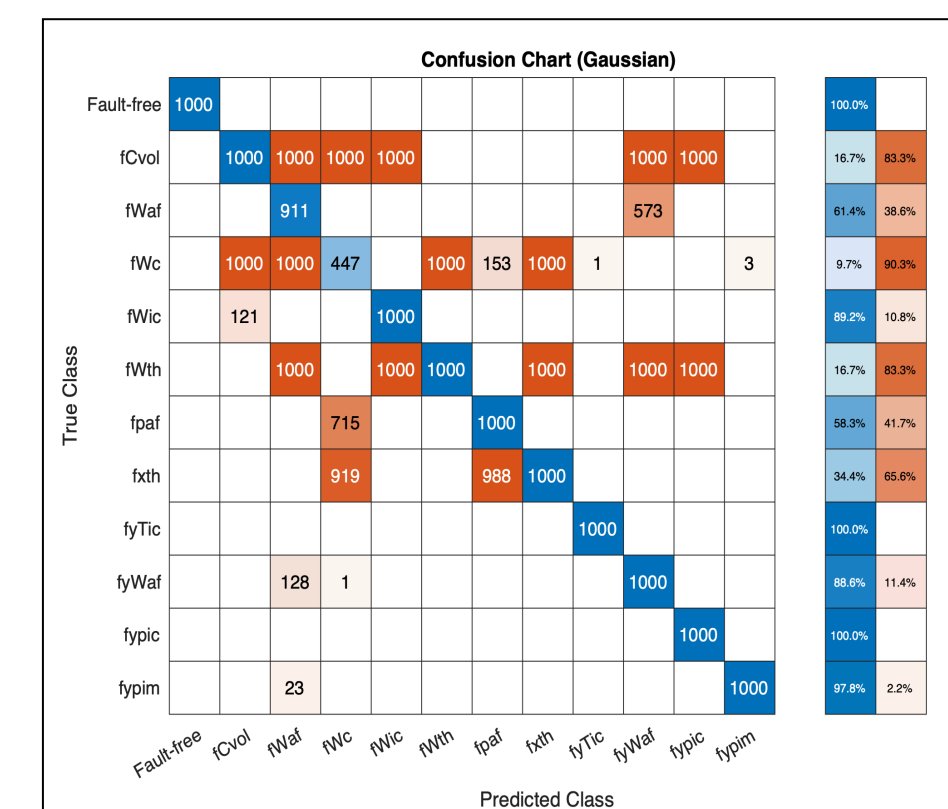


Simulation GUI and Telemetry Visualizations



Residuals Analysis

Multidimensional Data Analysis



Classification and Diagnosis



GitHub



IEEE CSM Paper

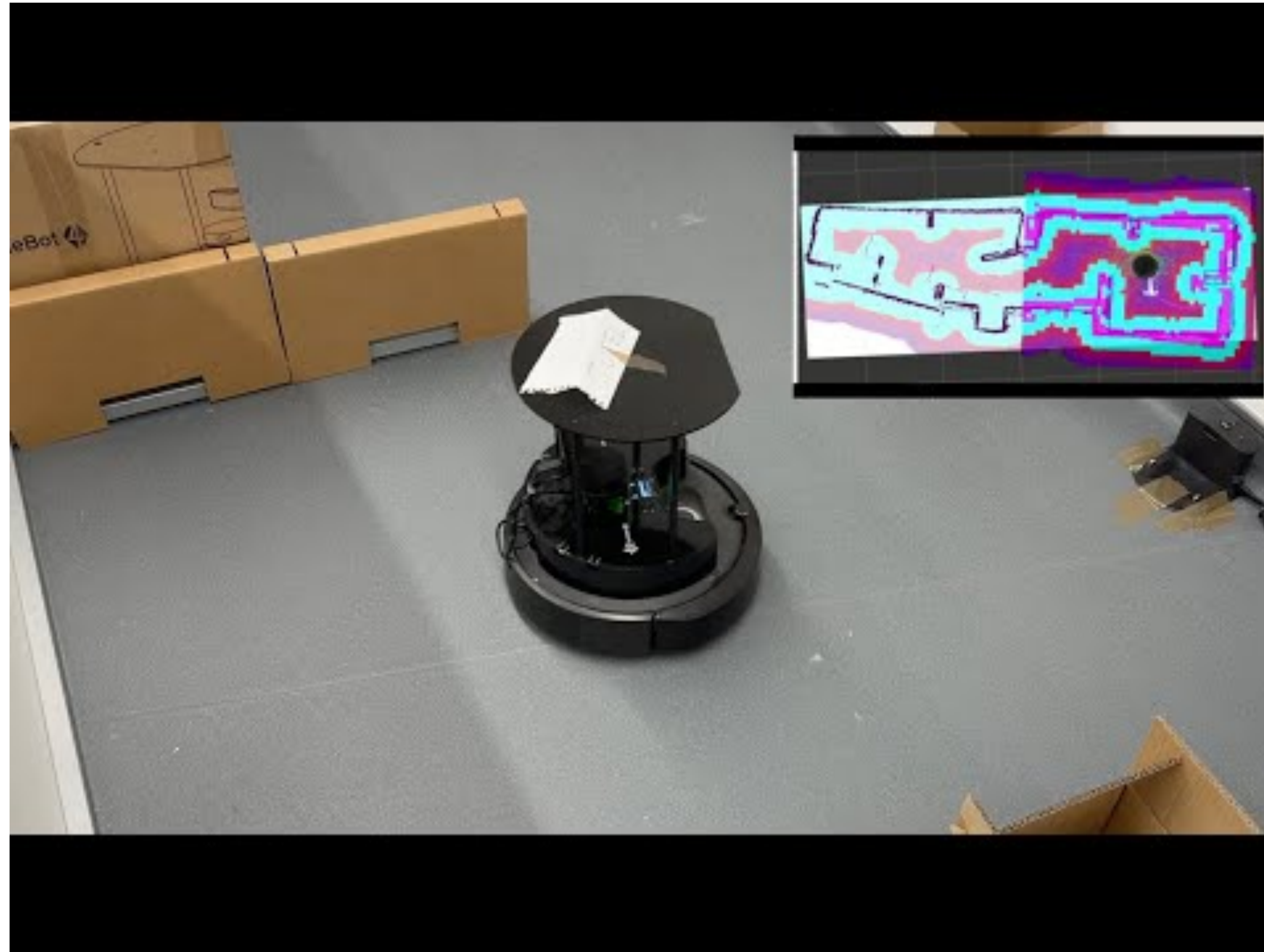
Key Achievements Thus Far...



<https://youtu.be/Q9RnzF0kwnM?si=OaTWwnjr1jn8MSKf>

Non-verbal robot-robot communication (Research paper in writing)

Key Achievements Thus Far...



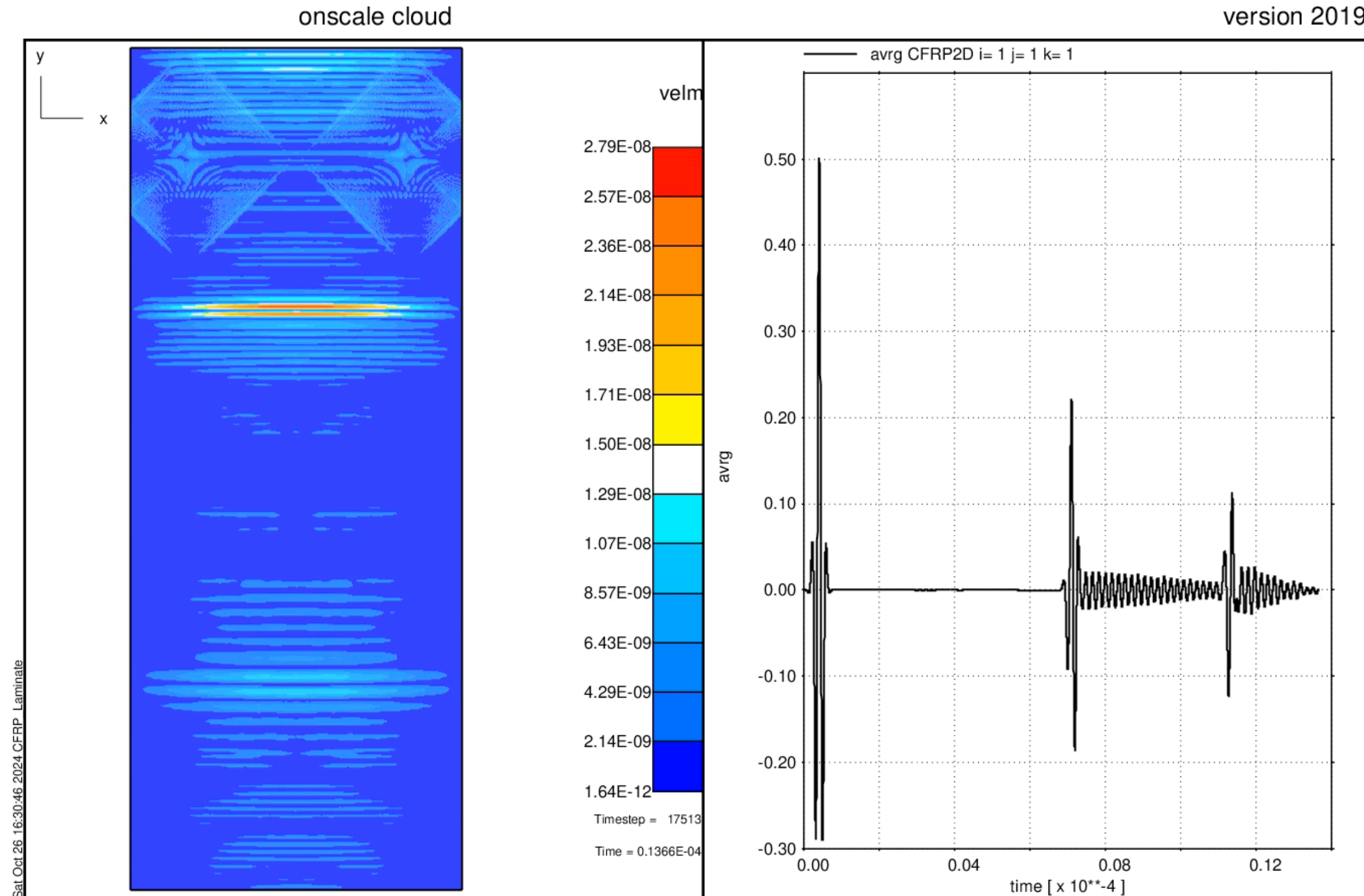
https://youtu.be/6QJiKrzK9bY?si=wmC_lo8Rxvqpczrt

Real-time Autonomous SLAM

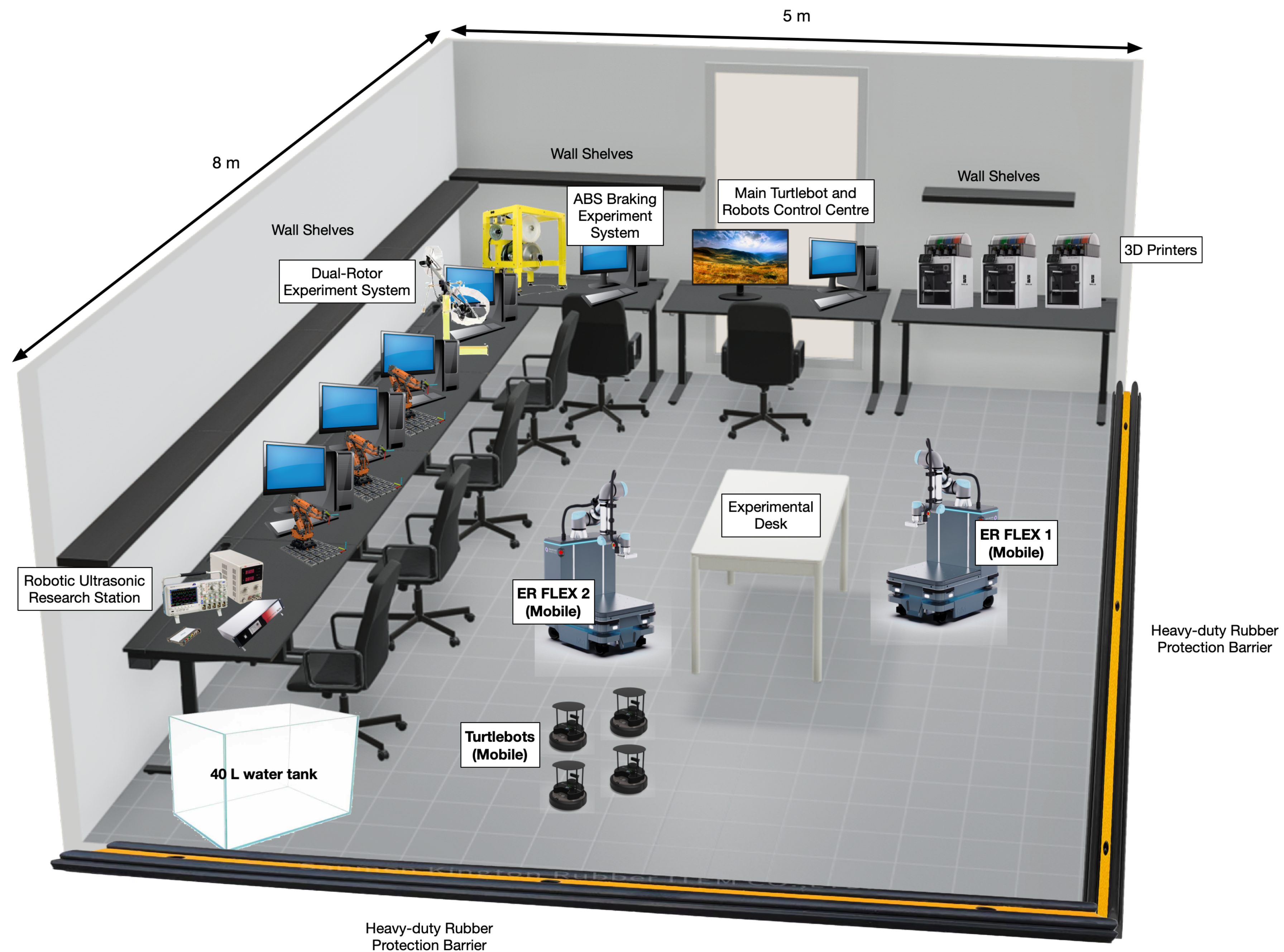
UT and Characterisation for NDT in Manufacturing and Healthcare Diagnosis



Key Achievements Thus Far...

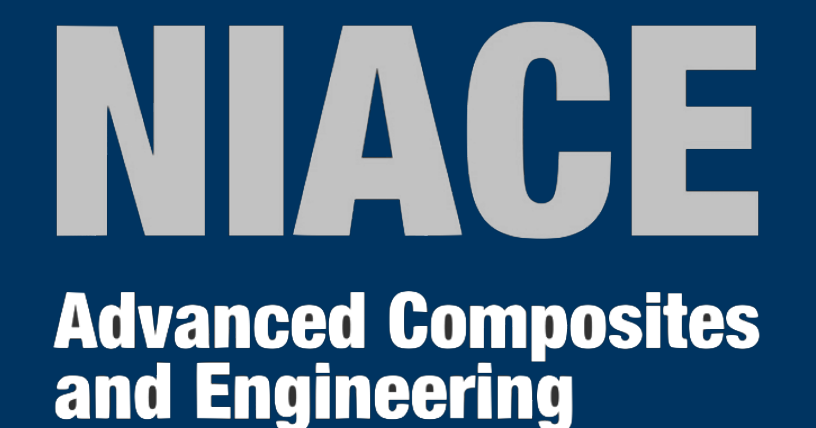
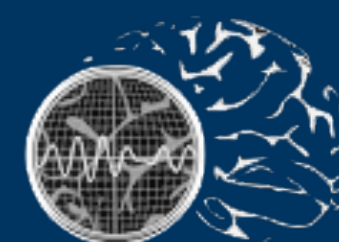
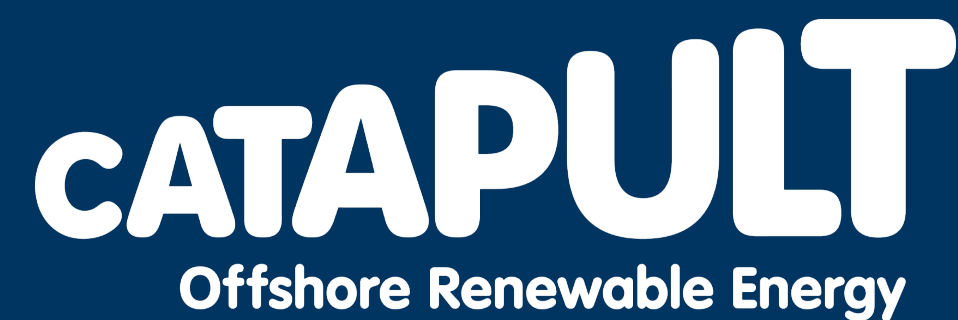


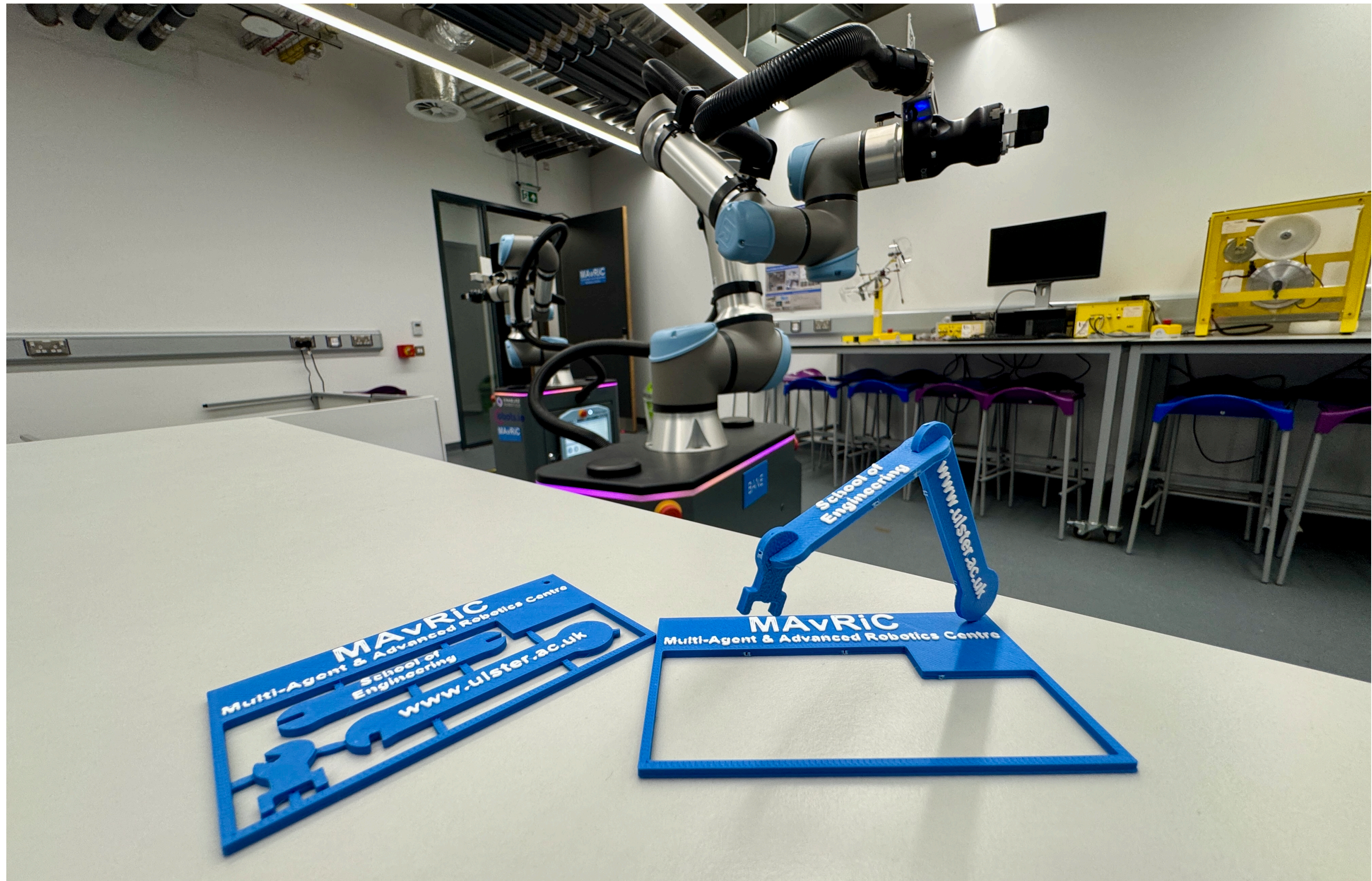
NDT of Composites Using UT



***NOT TO SCALE**

Research Collaborators and Partners





Thank You