

**Team RIL-IISc won the 03rd & 04th positions in the flagship IEEE International Robotics Competition (IROS 2021) held in Prague, the Czech Republic. It assessed two autonomy-based inspection tasks — precise navigation without GNSS and automatic defects-detection using advanced AI algorithms, respectively.**

Mr. Tharun V.P. and Mr. Suryaprakash R.J. (Team RIL-IISc) under the guidance of Dr. Abhra Roy Chowdhury of the Robotics Innovations Lab (RIL), CPDM has won the overall fourth place in Robotics for Asset Maintenance and Inspection (RAMI) in the area of inspection and maintenance (I&M) for two functionality benchmarks (FBM) i.e., precise navigation without global navigation satellite system (GNSS); and automatic detection of defects using advanced AI algorithms. The competition was held virtually during the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2021) which had been organized by CATEC (Advanced Center for Aerospace Technologies, Seville, Spain) – one of the reference research centres in Europe devoted to aerial robotic technologies in Prague, the Czech Republic between Sept 27 and Oct 1, 2021.

RIL@CPDM (<https://cpdm.iisc.ac.in/ril/>)

Robotics Innovations Lab (RIL) at CPDM, IISc is led by Dr. Abhra Roy Choudhury. It aims to create user-centric, trans-disciplinary, and hands-on learning programs in both teaching and research methods in Robotics & Autonomous Systems (RAS) with specialization in research, design, and development on ground, aerial, industrial, and social robotics. With a strong focus on end-user needs, the mission of RIL is to enhance competencies and trustworthiness of autonomous systems operating in complex scenarios, improve human collaborative technology, and enable innovative products and applications to real-world problems.

The METRICS Project (<https://metricsproject.eu/>)

The Metrological Evaluation and Testing of Robots in International Competitions (METRICS) project is led by the National Metrology and Testing Laboratory (LNE) in collaboration with 17 expert partners in robotics competition and metrology that have highly complementary testing facilities and networks. Under this initiative, robotics competitions are organized in four priority areas that the European Commission (EU) identified as Health, Agri-food, Inspection and Maintenance of infrastructure (I&M), and Agile production. METRICS organizes competitions as reproducible and objective evaluation campaigns designed to draw attention from the economic sector, academia, and digital innovation hubs (DIH) in Europe while stimulating public engagement. It would also implement a dedicated strategy to mobilize external partners and sponsors to support industrial relevance, promote robotics systems towards the general public, and ensure compliance of robots with ethical and socio-economic principles.

The RAMI Competition (<https://www.iros2021.org/rami-robotics-for-asset-maintenance-and-inspection>)

RAMI competition aims at addressing inspection and maintenance (I&M) tasks (which is one among the four priority areas as identified by EU) achieved by aerial and underwater robots, offering the possibility of increasing spatial/temporal resolution of the inspection process, improving the operation persistency, and quality of the acquired data. These robotic domains also can reduce operational costs and increase the safety

of workers (especially in dangerous areas) such as explosive atmosphere environments, works at height, etc. In order to tackle different challenges of the I&M sector and increase the added value of using robots, a high degree of autonomy is required, especially when a direct link with an operator cannot be guaranteed, or when inspection tasks need to be performed repetitively. Autonomous decisions can also increase the robot mission performance and ensure robot survival in hostile or cluttered environments where it would be challenging to teleoperate robots safely. In particular, RAMI will focus on oil, gas, and renewable energy sectors in both off-shore and on-shore facilities where commercial robots used for I&M are usually teleoperated, such as remotely operated vehicles or drones for visual inspection of large infrastructures in refineries. RAMI addresses this need by increasing, assessing, and evaluating the robot autonomy in I&M tasks.

**Team RIL-IISc, representing India, secured the 3rd & 4th position in FBM 1 and FBM 2 respectively, and an overall 4th position.** This competition has been one of the important international EU competitions that RIL officially participated, and it turned out to be a good learning experience for the team.

FINAL RESULTS		
IROS 2021 (FBM1 & FBM2)		
1	The Italian Job	
2	CVAR-UPM	
3	Team XL	
4	RIL-IISC	
FBM 1		
1	The Italian Job	0.762706 m
2	CVAR-UPM	3.156811 m
3	RIL-IISC	3.501756 m
4	Team XL	5.792044 m
FBM 2		
1	Team XL	0.559524
2	The Italian Job	0.513158
3	CVAR-UPM	0.118812
4	RIL-IISC	0.081482

The competition focused on aerial robots, and the evaluation process mainly involved tasks related to autonomous navigation and data acquisition for I&M purposes. The two different challenges or Functionality Benchmarks (FBM) which was evaluated virtually using data generated by the competition organizers were:

FBM1: precise navigation without GNSS, since I&M activities may take place in environments with poor GNSS coverage, or even indoors.

FBM2: automatic detection of defects using advanced AI algorithms, which is essential for inspectors when they face considerable amounts of data to review.

Competition task, solution, and full run videos are available at:

<https://cpdm.iisc.ac.in/ril/competitions/>

<https://metricsproject.eu/wp-content/uploads/2021/07/MetricsCompetitionDescription.pdf>

<https://metricsproject.eu/wp-content/uploads/2021/07/METRICS-RAMI-Evaluation-Plan.pdf>