Royal Academy of Engineering

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PROFILE
Distinguished International Associate

Thematic area: Additive manufacturing; welding; bio-corrosion of weld joints

Project title: Promoting a transdisciplinary research approach for diversified engineering applications using multi-functional materials and advanced processing technologies through industry and academic partnership.

Strategic goals: To solve some of the key problems in the manufacture of critical components used in both the aerospace and automotive industries.

Background: I became a Doctor of Philosophy in the area of weldment corrosion at VIT in July 2012, having achieved a First Class master's with distinction in CAD/CAM at the same institution in 2004. I was recognised as being in the top 2% of Indian scientists across all fields in a survey conducted by Stanford University, and I have had over 100 research articles published in journals of international repute. I am a life member of both the Indian Institute of Metals and the Indian Welding Society.

Previous Academy involvement: In collaboration with Cranfield University and Tata Advanced Systems, I received an Industry–Academia Partnership Programme (IAPP) grant from the Academy in 2019 for 'Enhancing research-based learning and teaching on advanced materials and manufacturing technologies for the aerospace sectors in India and UK'.

About my project

Objectives: The failure of industrial equipment, gas pipelines and military machinery due to microbiologically influenced corrosion (MIC) leads to billions of dollars in damage annually. MIC impedes the integrity of stainless steel alloys and is estimated to account for around 20% of all costs related to corrosion failures. The range of industries affected by MIC includes:

- onshore and offshore oil and gas
- marine and shipping
- nuclear power
- aviation
- sewage.

MIC studies on welded or additively manufactured structures have not been thoroughly explored in the aerospace, marine and nuclear sectors. My proposal extends an ongoing IAAP project on the use of advanced materials and manufacturing processes, developing multifunctional materials for aerospace, nuclear and marine applications.

The main objective is to develop wire plus laser additive manufacturing (WLAM) and wire plus arc additive manufacturing (WAAM) for producing critical components. These wire-based additive manufacturing technologies with the use of arc/laser sources will be adopted to develop components using stainless steels, titanium- and nickel-based alloys.

On the UK side... Between February 2021 and October 2022, joint student projects are being executed in collaboration with VIT, Cranfield University and Tata Advanced Materials Ltd. Post-MIC studies on developed components will be taught on Cranfield's postgraduate programme, followed by a joint UK–India industrial

brainstorming workshop to disseminate the knowledge developed. There will also be a three- or four-day industrially relevant training course.

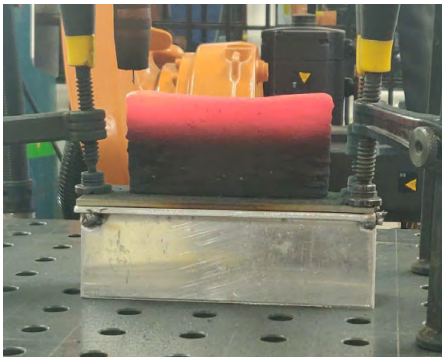
Project output: Firstly, I intend to develop novel concepts of multifunctional materials through innovative manufacturing practices and application of the latest-generation alloys. Brainstorming sessions will be performed to identify potential multifunctional materials.

The product lifecycle of multifunctional components obtained from these manufacturing methods will be assessed by exposure in actual service environments, and the technical outcomes from the works undertaken will give us confidence to integrate research findings into existing teaching units at VIT and Cranfield.

From here, I will build world-leading industrial technology-driven academic curriculum and professional development courses. I will organise joint undergraduate and postgraduate training internships, research projects, short courses on additive manufacturing, workshops, and teaching module development between industry and academic partners based in both the UK and India.

Key competencies will be honed through the development of lab-scale intricate components using micro and macro characterisation of components fabricated through advanced manufacturing processes, alongside structural integrity assessments of prototypes. Also, the product lifecycle will be assessed by exposing these components in actual service environments.

Anticipated outcomes and impact: A two-day international workshop on Manufacturing of



Advanced Structural Materials for Transport Systems was organised by VIT Vellore in collaboration with Cranfield University, with participants from industry and academia invited to take part.

We are also planning to conduct workshops and value-added programmes pertaining to the project activities. Other associates working in relevant fields will be invited to explore possible collaborative works, while a cross-functional team will be developed to demonstrate research among students who can then work on these real-time problems.

Final thoughts on the Distinguished International Associates programme: The undergraduate students are eager to start the project, as they love to contribute and work in transdisciplinary or interdisciplinary research works.

About the Distinguished International Associates Programme

The Distinguished International Associates Programme is an award scheme for international engineers working across all sectors, who are at the cutting edge of engineering research or innovation.

Awardees are offered a grant to amplify the impact of an existing collaboration with the UK in an area that aligns with the Academy's new strategic priority themes.

The programme aims to develop a broad international network of excellent diverse engineers across countries and disciplines, with research and innovation links to the UK, to work alongside the Academy to enhance progress towards achieving its goals for an inclusive economy and sustainable society.