The University of Queensland - IIT Delhi Academy of Research Joint PhD Project

Project title	**Coupled Digital Image Correlation and Particle Tracking (DIC/PT) Approach for Crack Growth Monitoring**
Project code	**UQIDAR 00223**
Project description	The measurement of displacement and deformation at any point of a structural element under far-field loads is crucial in many engineering applications. In recent years and with the rapid development of the market and the availability of new scientific breakthroughs, there is an even higher demand for the accuracy and efficiency of measurement technologies. Digital Image Correlation (DIC) is a popular contact-free deformation/strain measuring technique evolved in many fields of engineering since it was first introduced in the early 1980s. Simply speaking, DIC compares digital images of the test specimen's surface at different stages of deformation. The light intensity pattern of a pixel subset of the first image is stored and recognized in the subsequent images. By cross-correlating several subset pairs, a strain or deformation field can be calculated. DIC can be used in both two-dimensional (2D DIC with one camera) or three-dimensional (3D DIC with a minimum of two cameras) for full-field deformation, shape, and strain measurement. However, despite its very successful proven applications in material testing and monitoring, DIC has the drawback that it loses information when discontinuities (such as cracks) occur. On the other hand, Particle Tracking (PT) is a quantitative field measuring technique originally developed to track and measure the velocity of individual particles in fluid flows. PT identifies individual particles within each frame which are then tracked from frame to frame in order to establish particle-centred velocity estimates. While PT has the disadvantage that it requires discrete particles, it can capture crack growth and brittle failure processes effectively by tracking particles. This project aims to combine DIC and PT approaches for the study of materials pre-to-post brittle cracking stage where this transition has shown to be challenging for DIC and PT monitoring alone. The project will also be supported by Prof Roger Nokes from the University of Canterbury (New Zealand) who offered to act as external advisor.
Project outcomes	The proposed project consists of the following six overlapping stages: (i) virtual modelling to identify particle patterns optimised to work for both DIC and PT; (ii) extensive experimental (physical modelling) program combined with high-speed photography technique; (iii) development of a combined DIC/PT platform in MATLAB/Python; (iv) verification of the developed platform on standard testing techniques where closed form solutions are available; (v) testing and extending the platform applicability and methodology on other brittle solids; and (vi) publication of experimental results in high impact journals and presentation at conferences
Advisory team	**UQ Principal Supervisor** **Dr Mehdi Serati** Civil Engineering m.serati@uq.edu.au https://researchers.uq.edu.au/researcher/10399 **IITD PrincipalSupervisor**

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Type of student	Applications are open to: I or q students who meet eligibility criteria.
Discipline background of student	Ideally, this project requires students with a background in: Civil Engineering, Mechanical Engineering, Material testing, Fracture mechanics, MATLAB/Python/Java programming
Ideal candidate	**Essential Capabilities:** Knowledge in Geotechnical and/or Structural and/or Mechanical Engineering with high grades in academic subjects related to the project. At least basic programming skills. Willing and able to work in a lab environment. **Desirable Capabilities:** Experience in experimental testing and programming/coding in MATLAB/Python. In case the student does not have the relevant experience, the student will be encouraged to undertake additional studies in this field at UQ and/or IIT Delhi. Photography and ima **Expected qualifications (Courses/Degrees etc.):** Masters Degree in Mechanical Engineering, or Structural Engineering or Civil Engineering or a related discipline. Completion of courses on constitutive modelling, fracture mechanics, general material science, programming either prior to the project commen
Application process	Apply online by the due date: https://www.uqidar.org/students/how-to-apply/