3D reconstruction of thermal data for internal defect detection

Applications are invited for a PhD scholarship opportunity in the School of Engineering, at the University of Waikato, New Zealand. This PhD is an important part of a larger Royal Society of New Zealand, Marsden Fund Te Pūtea Rangahau funded project entitled: *Thermoelastic stress tomography: using heat to detect, map and quantifying the effect of hidden defects.* This work is a collaboration between the University of Waikato, Sigma Clermont Engineering School, France and the Defence Science and Technology Group, Australia.

Overall project summary: Current non-destructive evaluation approaches identify and size defects in structural components but cannot reveal if the defect is important. Current rules based on size alone can lead to unnecessary replacement, causing waste and costly down time. We propose a new approach to reveal internal defects, define their shape and, most critically, assess their importance, providing a route to more informed decision-making. Through advancing the underlying infrared thermography techniques, we can progress from two-dimensional surface-based capabilities to reconstructed '3D' assessments. This work will provide a novel approach to thermography, enabling 3D defect mapping. Further work will advance thermoelastic stress analysis, which relates a small reversible temperature change to the stresses on the surface of the part. The work will exploit heat transfer effects created during testing to access a subsurface response viewed from the surface. Fundamental relationships between the surface response and the subsurface stresses will be proposed to locate subsurface stress 'hotspots'. Through a robust experimental and modelling framework, these techniques will be combined to develop for the first time a non-destructive 3D stress assessment, providing deeper insight into defects and contributing towards safer and more sustainable design.

PhD summary: The focus of the PhD will be the exploration and development of 3D reconstruction approaches suited to thermal data. Work will begin by exploring the literature to identify current techniques, their potential and their limitations. Work will move on to assess non-thermal based methods and assess their suitability to thermography assessments. While a large portion of the work will be computationally based (including simulations and developing data processing and handling routines), the student will also plan, develop and carry out robust experimentation and data collection, enabling a wide range of skills to be developed.

<u>**PhD scholarship:**</u> $35 000 per annum + fees
<u>PhD duration:</u> 3 years (full-time); <u>Start date:</u> Early-mid 2022

Eligibility criteria:

Essential:
- 2:1 or above in a minimum four-year degree in a related discipline such as Mechanical/ Mechatronics/Electronics Engineering or Applied Physics.
- Experience in Matlab and/or FEA (such as Ansys)
- Experience in signal and/or image processing
- University of Waikato PhD entry requirements

Desirable:
- Masters by research qualification

Application documents required:

- CV
- 2 References (Academic and Character)

Contact and email address for applications:

Prior to application, please contact Dr Rachael TIGHE for further information
rachael.tighe@waikato.ac.nz

Closing date: Open until filled