



MSE Seminar:

## **A Multiscale Approach to the Mechanical Behaviour of Braided Composites through Finite Element Modelling with Experimental Support**

**Professor Chen Zhong**

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### **Abstract**

Braided textile-reinforced composites have become increasingly attractive for light-weight structural / protective applications due to their unique inter-weaving structures with excellent energy absorption capacity. However, accurately modelling and simulating the mechanical behaviour, which requires mechanically describing the braided structures and computationally predicting the micro/macro damage processes, is a challenging task. In this talk, a multi-scale modelling approach is presented for the prediction of the ultimate mechanical strength, energy absorption, and the progressive damage of braided textile composites. A micro-scale model is first built with hexagonal arrays of fibres to compute effective elastic constants and strength of yarn under different loading conditions. To ensure good accuracy for subsequent computations, the input parameters of micro-scale model are obtained from experimental measurement of single fibres and matrix resin. Subsequently, the results of micro-scale modelling are used as input of the homogenized material properties for the meso-scale model. Hashin's 3D and Stassi's failure criteria, together with a stiffness-degradation scheme, are applied to the meso-scale representative unit cells (RUCs) by a user-defined subroutine in the finite element program. The overall stress-strain curve of the meso-scale RUC model is verified by experimental test data. The validated meso-scale elements can then be applied to the design of large (macro) structures through the prediction of their mechanical behaviour (stiffness, strength, energy absorption, damage tolerance, etc.) before they are manufactured and tested.

### **Biography**

Chen Zhong obtained his PhD from the University of Reading under the sponsorship of an ORS award and a European Union research grant. After graduation, he joined the newly established Institute of Materials Research and Engineering under the National Science and Technology Board (NSTB, currently known as A\*Star) in 1997. In March 2000, he moved to Nanyang Technological University (NTU) as an Assistant Professor in the School of Applied Science and has since been promoted to Associate Professor and Professor in the School of Materials Science and Engineering. Prof. Chen's research interests include 1) Surface Engineering and 2) Mechanical & Long-term Behaviours of Materials. Since joining NTU, Prof. Chen has graduated 35 PhD and 6 MEng students. He has also supervised over 200 undergraduate projects (FYP, URECA). According to Google Scholar, his papers have received over 30,000 citations with the h-index of 93. He has been recognized as a globally Highly Cited Researcher by Clarivate and Top 2% Scientist by Stanford University since 2019.

**Wednesday, 21 February 2024 || Time: 2:00 pm – 3:00 pm ||**

**MSE Meeting Room 1 (N4.1-01-28)**

**Please register [here](#).**

**Hosted by: Associate Professor Li Shuzhou**