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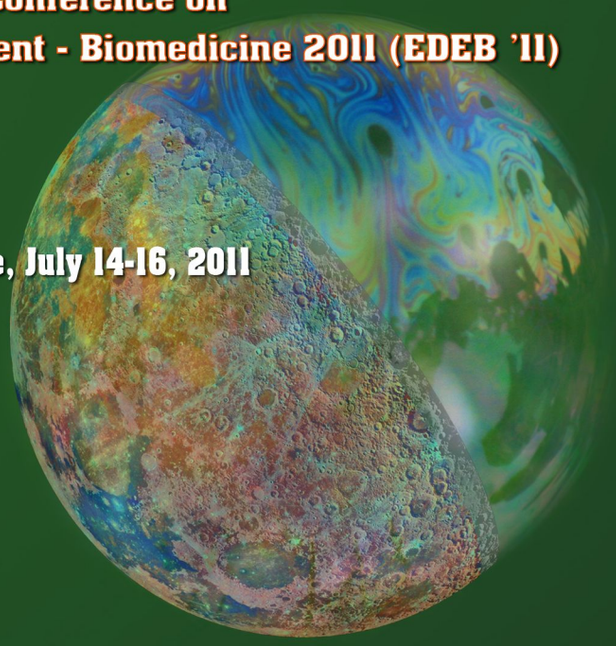

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Plenary Lecture 1

Partition and Propagation of Delamination in Fibre Reinforced Composite Laminates

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Abstract: Fibre reinforced composite laminates are very attractive to manufacturers of light weight structures in several industrial sectors, such as aeronautical, automotive and ship industries. However, delamination has always been a major concern in their applications due to the possibility of caused catastrophic structural failures. Consequently, their competing ability is considerably compromised against advanced metallic alloys. To improve the situation, it is of paramount importance at present time to understand the mechanics of delamination and its propagation. This lecture focuses on this topic. Analytical, numerical and experimental studies are reported.
In our study, delamination is regarded as a mixed mode fracture and strain energy release rate is considered as a quadratic form of positive definite of local crack tip forces and moments. Two sets of orthogonal pure modes are discovered. One set is proved to be a complete basis and is used to partition any mixed delamination mode. Although the individual pure modes in a pure pair are orthogonal, they still interact to each other in a stealthy way which results in a net zero energy change within the pair. However, the stealthy interaction results in energy flow between the orthogonal pure modes which changes mode energy partitions. Numerically, laminar interfaces are modelled by using imaginary springs. Strain energy release rates are calculated by using crack closure technique. An XFSM is developed based on a layer-wise theory to study the propagation of delamination in generally anisotropic laminates under compression. Extensive analytical, numerical and experimental studies are presented The results show that unstable propagation is often caused by mode I delamination whilst mode II delamination often leads to stable propagation. Multiple delaminations interact with each other and considerably change the propagation behaviour.

Brief Biography of the Speaker:
Simon S. Wang received his BSc and MSc education from Tsinghua University of China between 1978 and 1985. He obtained his PhD from Birmingham University of UK in 1990 and worked as a post doctoral research fellow in the same institution from 1991 to1996. He joined Loughborough University of UK in 1996 as a lecturer and became a senior lecturer in 2003. He is now a concurrent professor of Hebei University of Engineering of China. He is the author of over 100 academic papers in international journals and conferences. He has been frequently invited to give plenary and keynote presentations in international conferences and research lectures in prestigious research institutions.