MULTI-PHYSICS PHASE FIELD MODELLING OF FRACTURE, FATIGUE AND ENVIRONMENTAL DAMAGE

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ABSTRACT

The phase field method has emerged as a promising mathematical model for solving interfacial problems. First proposed for modelling microstructural evolution, phase field is now the *de facto* tool in a wide variety of physical problems, from viscous fingering to vesicle dynamics. One of the areas where the phase field method is enjoying a remarkable success is fracture mechanics, a discipline that has long attracted a great deal of interest from the computational mechanics community.

In this talk, I will describe the theoretical foundations of phase field fracture methods, discuss implementation details and showcase some of the pioneering applications pursued by my group. Emphasis will be placed on the application of phase field models to multi-physics problems, with particular focus on hydrogen embrittlement – a long-standing scientific challenge that has come very much to the fore in recent years due to the need of developing structures for (hydrogen) energy storage. Moreover, I will show how our phase field models for hydrogen embrittlement have been benchmarked against experimental results and are currently being used by industrial partners to conduct *Virtual Testing*, for the first time in the energy sector (wind energy and Oil&Gas). Finally, I will show how the phase field paradigm can also open new modelling horizons in another scientifically-challenging phenomenon of notable technological importance: corrosion damage.

SHORT BIO

Emilio Martínez Pañeda is a Lecturer (US Asst. Professor) and 1851 Research Fellow at Imperial College London, where he leads the Mechanics of Infrastructure Materials Lab. Before, he was a Research Fellow at the University of Cambridge. During his 7-year academic career (PhD Thesis: 2013-2016), Emilio has published 44 scientific papers (h-index: 16), supervised 12 PhD students and attracted and managed over £1M in research funding. Emilio has been the recipient of a number of competitive fellowships such as the 1851 Research Fellowships, the Marie Curie Individual Fellowship, the H.C. Ørsted Fellowship or the Wolfson College (Cambridge) Junior Research Fellowship. His current research interests lie in the field of applied mechanics; more specifically fracture mechanics, coupled diffusion-deformation theories, and computational mechanics. Emilio's work has been recognized through several awards, including the Acta Student Award, the Springer PhD Thesis Prize, the Brunel Award, the Keith Miller Prize, the Extraordinary Doctoral Prize and the IMechE Prestige Award for Risk Reduction in Mechanical Engineering. In 2020, the Spanish Society for Numerical Methods in Engineering awarded Emilio the Simó Prize.