# DCAMM SEMINAR

APPLIED MATHEMATICS AND MECHANICS

FS945 8 November 2018

A DCAMM seminar No. 733 will be presented by

**Emilio Martínez-Pañeda, 1851 Research Fellow**
**Department of Engineering**
**Cambridge University, United Kingdom**

The title of the lecture is

## Towards Virtual Testing in Hydrogen-Rich Environments

**Abstract:**

Hydrogen is ubiquitous and has remarkable properties. It is the lightest of the elements and it diffuses rapidly through the lattice of solid materials. The use of hydrogen as energy carrier is one of the most promising solutions to our energy crisis; hydrogen-powered cars and trains are already in the market. However, hydrogen is also famed for causing catastrophic failures in metallic components. The ductility and fracture resistance are drastically reduced in the presence of hydrogen and these effects increase with the strength of the metal; a 90% reduction in fracture toughness is observed in high strength steels. Decades of metallurgical progress are effectively compromised by the effect of hydrogen. A problem that was mainly relevant to aggressive environments, e.g. oil and gas extraction, has now important economic consequences in numerous applications, from bridges to wind turbines.

The speaker and his collaborators have been engaged in the development of models capable of predicting hydrogen assisted cracking as a function of the environment, the material and the loading conditions. To solve this longstanding challenge research efforts were focused on four fronts: (1) the mechanisms of hydrogen embrittlement, (2) the plastic response at the small scales involved in crack tip deformation, (3) the characterization of hydrogen transport and the electrochemistry-diffusion interface, and (4) the development of robust numerical methods for crack propagation. The combination of these efforts into a mechanism-based framework for hydrogen embrittlement led to an unprecedented level agreement with experimental measurements. The promising results achieved over a wide range of scenarios have attracted the interest of industrial partners and technical standards organizations, paving the way to extending the success of Virtual Testing in the automotive and aeronautical industries to hydrogen-sensitive applications.

DATE: **Wednesday, 21 November 2018**

TIME: **14:00 – 14:45 + questions**

PLACE: **Room 065E (027), Building 414**
DTU, Technical University of Denmark

Danish pastry, coffee and tea will be served 15 minutes before the seminar starts.

All interested persons are invited.

Niels Leergaard Pedersen