KTH SOLID MECHANICS SEMINAR; Thursday, January 28th, 15.15; KTH Solid Mechanics Seminar room

Peter McHugh

"Magnesium Biodegradable Stents: A Computational Test-Bed for Analysis and Design Assessment"

Stents have revolutionised the treatment of arterial disease. Acting as a supporting scaffold, these small mesh devices are now routinely inserted into arteries where the blood flow has become dangerously restricted. In relation to coronary stents, one of the most fertile technological growth areas is biodegradable stents; here there is the possibility to generate stents that will break down in the body once the initial necessary scaffolding period is past (6-12 months) and when the artery has remodelled (including the formation of neo-intima). This brings advantages including the possibly of reduced risk of in-stent restenosis and late stent thrombosis, and the restoration of vasomotion potential. This is a very exciting technology and stents based on both metal and polymer platforms are emerging.

In this presentation a method to simulate the degradation of metal stents (magnesium alloy) is summarised, and implications for stent scaffolding performance presented. A stent angioplasty computational test-bed has been developed by the authors, based on the Abaqus software (DS-SIMULIA, USA), capable of simulating stent tracking, balloon expansion, recoil and in-vivo loading, in an atherosclerotic artery model. Additionally, a surface corrosion model has been developed and calibrated against experimental corrosion data for Magnesium alloy AZ31, and implemented in Abaqus/Explicit. The model is implemented in the computation test-bed and used for stent analysis and design simulations. The test-bed is enhanced to incorporate the representation of arterial remodelling. Recommendations are made on future stent design in relation to fundamental material properties and the optimization of stent geometry to maximize stent scaffolding support.

Peter McHugh is Professor of Biomedical Engineering at NUI Galway. He holds a BE in Mechanical Engineering from UCG (1987), and an MSc (1990) and PhD (1992) in Mechanics of Solids from Brown University, Providence, USA. He joined NUI Galway in 1991, where he is currently the Established Professor of Biomedical Engineering and Head of Discipline of Biomedical Engineering, within the College of Engineering and Informatics. His research is focused on applying computational and experimental methods to investigate the mechanics of medical devices, tissue and the interaction of tissue with implanted devices. He is also Director of the Biomechanics Research Centre (BMEC), affiliated with the National Centre for Biomedical Engineering Science (NCBES) at NUI Galway. He has a significant publication record, with over 126 refereed journal publications, 8 book chapters and over 300 conference publications. He has supervised to completion 25 PhD and 23 research masters students. He has generated over €10m in research funding from national, EU and industry sources. He is currently Associate Editor of the Annals of Biomedical Engineering, and Cardiovascular Engineering and Technology. He has received numerous awards, including membership of the Royal Irish Academy, Ireland's national academy for the sciences and humanities (2011), the Silver Medal of the Royal Academy of Medicine in Ireland (Section of Bioengineering) in 2011, the Presidential Nominee Fellowship of Engineers Ireland in (2009), and the Alexander von Humboldt Fellowship (1995). In 2015 he was appointed Secretary for Science of the Royal Irish Academy.

This presentation is co-authored by J.A. Grogan[1], C. Conway[1], B.J. O'Brien[1], J.P. McGarry[1], S.B. Leen[2], P.E. McHugh[1],
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