

## **Simulations of cell seeding and cell mechanical forces in tissue engineering**

Prof. Damien Lacroix

Department of Mechanical Engineering, University of Sheffield, UK

[www.mechanobiology.co.uk](http://www.mechanobiology.co.uk)

Email: [D.Lacroix@sheffield.ac.uk](mailto:D.Lacroix@sheffield.ac.uk)



Tissue engineering has become a new promising field of research with high prospects of being able to generate any kind of tissues at will. However, after more than ten years of research little is still known on the exact mechanisms of interactions between cells, biomaterials and external stimuli. One of the important processes affecting cell behavior is mechanotransduction, i.e. how the mechanical loading applied on the body is translated onto the cells. In order to better understand this load transfer computational models are being developed. Based on some mechanoregulation laws, the migration, proliferation and differentiation of cells can be predicted. In this study the simulation of cell seeding in a tissue engineering scaffold will be presented. It is shown how the macroscopic external loading applied onto the scaffold is of a different magnitude than the microscopic loading transduced at the scale level. A new methodology to simulate cell seeding enables to predict cell distribution within a scaffold and to optimize cell seeding as a function of cell density, pore shape and pore size. A single cell finite element model will also be presented to show the contribution of each component of the cytoskeleton structure. In conclusion computational models are useful to optimize the cell seeding process depending on the type of scaffold chosen and in calculating the local mechanical stimuli affecting cells while it is practically impossible to measure it experimentally. It is believed that such approach will provide in the future a rationale for the consistent design of tissue engineering scaffolds.

### **Short Biosketch**

Damien Lacroix is Professor of Mechanobiology in the Department of Mechanical Engineering of the University of Sheffield, UK. He has a first degree in Mechanical Engineering from the National Institute of Applied Science (INSA Lyon, France) and a PhD in Biomechanics from Trinity College Dublin. After various post-doc and fellowships in France and Spain, he was Group Leader of Biomechanics and Mechanobiology from 2008 at the Institute of Bioengineering of Catalonia (Spain). Damien joined the University of Sheffield in 2012 when he took a Chair in Biomedical Engineering within the INSIGNEO research institute. His main research activities include virtual physiological human modelling, mechanobiology, tissue engineering, lumbar disc degeneration, implant design, and cell mechanics.