Contribution ID: **406**　　Type: **Oral Presentation**

Homogenisation of a two-phase, elastic-poroelastic model of a fibre-reinforced hydrogels for tissue engineering of cartilage

Monday, 9 July 2018 11:00 (30 minutes)

Tissue engineering aims to grow artificial tissues to replace those that have been damaged through age, trauma or disease. A recent approach to engineer artificial cartilage involves seeding cells within a scaffold consisting of an interconnected three dimensional printed lattice of polymer fibres combined with a cast or printed hydrogel, and subjecting the construct (cell-seeded scaffold) to an applied load in a bioreactor. A key question is understanding how the applied load is distributed throughout the construct to the mechanosensitive cells.

To address this question, we view the scaffold as a two-phase mixture, in which the fibres are modelled as a linear elastic material and the hydrogel as a poroelastic material. We exploit the disparate length scales (small inter-fibre spacing compared with construct dimensions) and use homogenisation theory to derive macroscale equations for the effective mechanical properties of the composite material. The resulting governing equations reflect the orthotropic nature of the composite. We then validate the model, by comparing results generated from finite element simulations of the macroscale, homogenised equations to experimental data describing the unconfined compression of the fibre-reinforced hydrogels.

Primary authors: Prof. BYRNE, Helen (University of Oxford); Dr CHEN, Mike (University of Adelaide); Prof. WATERS, Sarah (University of Oxford); Prof. PLEASE, Colin (University of Oxford); Prof. WHITELEY, Jonathan (University of Oxford)

Presenter: Prof. BYRNE, Helen (University of Oxford)

Session Classification: The multiphase approach to tissue modelling: Applications in development and disease

Track Classification: Minisymposium: The Multiphase Approach to Tissue Modelling: Applications in Development and Disease