Plenary Lecture
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Poro-Hyperelasticity: The Mechanics of Fluid-Saturated Soft Tissues

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Abstract
The lecture presents the formulation of the mechanics of a fluid-saturated porous medium where the porous skeleton can undergo hyper-elastic deformations. The modelling has potential applications in the study of highly deformable biological tissues including brain matter, synthetic materials impregnated with fluids and highly deformable porous solids used as tactile sensors, where the fluid can be the air present in the void space. Conventional treatments of soft biological materials assume the applicability of classical hyperelasticity. The presence of the saturating fluid, however, completely changes the character of the modelling approach, in that the partitioning of stresses between the fluid and the porous skeleton needs to be addressed. The flow of the saturating fluid, induced by hydraulic gradients, is an added consideration. The presentation summarizes recent analytical results for canonical problems involving one-dimensional strains, pure shear and expansion of annuli. The role of these developments in the validation of computational schemes that can ultimately be used in the solution of problems with complex geometries is also discussed. The material presented in the plenary lecture is a summary of recent articles [1-4] on the topic.

References
[1] Selvadurai, A.P.S. and Suvorov, A.P. (2016) Coupled hydro-mechanical effects in a poro-hyperelastic material, *Journal of the Mechanics and Physics of Solids*, 91: 311-333.
[2] Suvorov, A.P. and Selvadurai, A.P.S. (2016) On poro-hyperelastic shear, *Journal of the Mechanics and Physics of Solids*, 96: 445-459.
[3] Selvadurai, A.P.S. and Suvorov, A.P. (2017) On the inflation of poro-hyperelastic annuli, *Journal of the Mechanics and Physics of Solids*, 107: 229-252
[4] Selvadurai, A.P.S. and Suvorov, A.P. (2018) On the development of instabilities in an annulus and a shell composed of a poro-hyperelastic material, *Proceedings of the Royal Society, Mathematical and Physical Sciences Series A*, https://dx.doi.org/10.6084/m9.figshare.c.4271114.