Muti Phasic Flows and Applications

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Mathematical Modeling for multiphasic phenomena has attracted the attention of many researchers. Among others we have problems modeling industrial filltration, blood flows etc... In this work we present two real applications, one problem from industry and another in medicine.

First, we develop a simplified formulation of the hydrocarbon system used for the petroleum reservoirs simulation. This system is a simplified model which describes a two-phase flow (oil and gas) with a mass transfer in a porous medium, that leads to the fluid compressibility. This kind of flow is modeled by a system of parabolic degenerated non linear convection diffusion equations. Under certrain hypothesis, such as validity of Darcy.s law, incompressibility of the porous medium, compressibility of the fluids, mass transfer between oil and gas and negligible gravity, the global pressure is formulated. This formulation allows to establish theoretical results on the existence and uniqueness of the solution. To validate these results, numerical simulations have been implemented.

Secondly, a problem for stem cell therapy in medecine is considered. Characterised by the ability of self-renewal and multipotency, stem cells have been put under both the literal and metaphorical microscope and are now seated as the potential cure for innumerable diseases. Usually these cellular therapies introduce cells through local delivery. Here we develop a bi-phasic model coupling the fluid (blood fow) and the level set (cell motion). A mathematical analysis of the model is detailed and numerical results are presented.