Computational modeling of active biogels and cell movement

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Biogels are complex fluids made up of biopolymer networks, biopolymer-producing mircoorganisms and nutrient rich solvent. Hydrodynamical interaction among the multiple constituents in the biogel under flowing condition leads to various interesting natural and man-made phenomena. One of the noticeable biogels is the biofilm which grows on supportive substrates in damp environment.It is of great medical interests for one to understand the transport phenomenon in biofilms, especially, antibacterial agent transport. In a living cell, the cytoplasm consists of various actin-filament, microtubes, free G-protein monomers and various regulatory proteins which can polymerize into F-actin filaments and regulate the polymer/depolymerization process to provide structural support for the cell and thereby impact on the cell motility. In this talk, I will discuss some recent computational modeling efforts in using active biogel models to study cell movement and full 3-D simulations of transport phenomena in biofilm formation as well as interaction with ambient fluid flows. I will also discuss the numerical implementation on CPU-GPU hybrid architecture using CUDA for the complex fluid models.