APPLIED MATHEMATICS COLLOQUIUM

Date: Wednesday March 29, 2017
Time: 2:30 – 3:30 pm
Location: MC Room 204

Regularisation Based Time-adaptive Solution For a Class of Highly Degenerate Diffusion-Reaction Systems With Gradient Blow-up

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Abstract: Starting point will be a density-dependent diffusion-reaction equation with two non-linear effects: (i) a high order degeneracy as the dependent variable vanishes [as in the porous medium equation], and (ii) a super-diffusion singularity as the the dependent variable approaches its upper bound. A characteristic feature of the solutions of this type of equations is that they have compact support if the initial data are compactly supported, leading to a finite speed of interface propagation. At the interface the gradient blows up and the transition between both nonlinear effects is immediate. This poses challenges for the numerical solution, which may include interface smearing effects, spurious oscillations, and strong stiffness.

To show how these can be overcome, I will introduce a regularisation that allows us to use efficient time-adaptive integration techniques.

To demonstrate the utility of the method, I will present applications to biofilm modeling, where this type of equations has its origin. Time permitting, I will also speak about extensions to systems that involve several degenerate equations. This is joint work with Maryam Ghasemi.