Nonlinear diffusion and additional cross-diffusion in the Keller-Segel model

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The main feature of the two-dimensional Keller-Segel model is the blow-up behaviour of solutions for supercritical masses. We introduce a regularisation of the fully parabolic system by adding a cross-diffusion term to the equation for the chemical substance. This regularisation provides another helpful entropy dissipation term allowing to prove global existence of solutions for any initial mass. In the parabolic-elliptic case this model can be reformulated to the Keller-Segel model with nonlinear cell diffusion of porous medium type. Therefore solutions are known to be globally bounded.

In the second part of the talk we return to the fully parabolic model and replace the cell diffusion and the additional cross-diffusion by nonlinear versions. We investigate the necessary conditions on the cross-diffusion perturbation such that we can allow even for a fast cell diffusion.

Numerical simulations will be presented.