Aobayama Cross-Diffusion Summer Seminar

Date: 31 July 2026

Venue: Room 209, Mathematics Building, Tohoku University

Seminar website: `http://www.math.tohoku.ac.jp/~fujie/ACDSS.html`

Program

13:30 – 14:00 Welcome coffee

14:00 – 14:40 Maria Heitzinger (TU Wien)
Weak-strong uniqueness for cross-diffusion systems

14:50 – 15:30 Noah Geltner (TU Wien)
Analysis of a degenerate chemotaxis system including volume-filling effects

15:40 – 16:00 Coffee break

16:00 – 16:30 Osuke Shibata (Tokyo University of Science)
Existence and uniqueness of solutions to degenerate volume-filling chemotaxis systems with source terms

16:40 – 17:20 Yuri Soga (Tohoku University)
Heat kernel and nonlinear self-similar asymptotics for aggregation-diffusion equations

17:30 – 18:00 Discussion & Networking

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Organizer: Kentaro Fujie (Tohoku University)

List of Abstracts

Maria Heitzinger (TU Wien)

Weak-strong uniqueness for cross-diffusion systems

We present the weak-strong uniqueness property for a general class of cross-diffusion systems. The core strategy relies on the relative entropy method. It uses a functional to compare a weak and a smooth, strong solution. Commonly, the strong solution is assumed to fulfill restrictive conditions. By regularisation of the entropy functional, we prove the weak-strong uniqueness without relying on nonphysical regularity assumptions of the strong solution. This result covers many important cross-diffusion systems fulfilling certain structural requirements. We present relevant examples.

Noah Geltner (TU Wien)

Analysis of a degenerate chemotaxis system including volume-filling effects

This talk concerns a degenerate Keller–Segel system with volume-filling effects. The system combines nonlinear diffusion with a chemotactic drift which both decrease as the population density approaches a maximal packing threshold, leading to significant analytical challenges due to degeneracy and cross-diffusion. Besides the existence result, we show weak strong uniqueness under suitable assumptions by using an entropy structure. We also analyse the steady states and asymptotic limits of the model, showing convergence to reduced systems in appropriate parameter regimes. Finally, we discuss the extension to multi-species chemotaxis systems with volume filling, where several populations interact in the limited space. This is a joint work with A. Jüngel and M. Zhang.

Osuke Shibata (Tokyo University of Science)

Existence and uniqueness of solutions to degenerate volume-filling chemotaxis systems with source terms

We consider a no-flux initial-boundary value problem for the degenerate volume-filling chemotaxis system with source terms. We prove that there exists a global weak solution. Moreover, under some additional conditions, we show uniqueness of global weak solutions.

Yuri Soga (Tohoku University)

Heat kernel and nonlinear self-similar asymptotics for aggregation-diffusion equations

We consider the large-time behavior of aggregation-diffusion equations with nonlocal interaction. First, we assume regular interaction kernels and establish heat kernel asymptotics under weaker assumptions than those imposed by Carrillo, Gómez-Castro, Yao and Zeng (2023). Our proof is based on decay estimates and Duhamel's formula, and does not rely on their entropy method or the use of self-similar variables. We next discuss the critical logarithmic interaction. In this case, the interaction remains visible under the diffusive scaling, and the asymptotic profile is described by a nonlinear self-similar solution. We prove uniqueness of this self-similar solution for every prescribed mass and show convergence toward it after rescaling, based on the repulsive structure of the logarithmic interaction energy. This is a joint work with Grzegorz Karch (Uniwersytet Wrocławski).
