

## **Ansgar Jungel (talk 15): Structure-preserving finite-volume methods for cross-diffusion systems and discrete chain rules**

*Thursday, June 12, 2025 4:00 PM (45 minutes)*

Many thermodynamic mixture and biological multicomponent models can be described by cross-diffusion systems. Although the diffusion matrices are generally neither symmetric and nor positive definite, the systems often possess an entropy (or free energy) structure. We aim to “translate” this entropy structure to fully discrete finite-volume discretizations. The main difficulty is to adapt the nonlinear chain rule to the discrete level.

In this talk, we present two strategies to define a discrete chain rule, assuming either that the entropy is the sum of individual entropies or that the entropy describes volume-filling models. Both strategies use suitable mean formulas, based on the mean-value theorem and the convexity of the entropy functional and work for the implicit Euler scheme. This leads to convergent and structure-preserving finite-volume schemes. Examples include models for segregating populations and Maxwell-Stefan systems for gas mixtures. Extensions to higher-order time approximations are discussed too.