ASYMPTOTIC GRADIENT FLOW STRUCTURES IN INTERACTING PARTICLE SYSTEMS

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ABSTRACT

In this talk, we present a cross-diffusion PDE system for a mixture of hard spheres, which was derived from a stochastic system of interacting Brownian particles using the method of matched asymptotic expansions. The resulting cross-diffusion system is valid in the limit of small volume fraction of particles. While the system has a gradient flow structure in the symmetric case of all particles having the same size and diffusivity, this is not valid in general. We discuss local stability and global existence for the symmetric case using the gradient flow structure and entropy variable techniques. For the general case, we introduce the concept of an asymptotic gradient flow structure and show how it can be used to study the behavior of solutions. Finally, we illustrate the behavior of the model with various numerical simulations.

REFERENCES

[1] Bruna, Maria, Martin Burger, Helene Ranetbauer, and Marie-Therese Wolfram. "Cross-diffusion systems with excluded-volume effects and asymptotic gradient flow structures." Journal of Nonlinear Science 27, no. 2 (2017): 687-719.

[2] Bruna, Maria, Martin Burger, Helene Ranetbauer, and Marie-Therese Wolfram. "Asymptotic gradient flow structures of a nonlinear Fokker-Planck equation." arXiv:1708.07304v3 (2018).

[3] Bruna, Maria, and S. Jonathan Chapman. "Diffusion of multiple species with excluded-volume effects." The Journal of chemical physics 137, no. 20 (2012): 204116.

[4] Bruna, Maria, and S. Jonathan Chapman. "Excluded-volume effects in the diffusion of hard spheres." Physical Review E 85, no. 1 (2012): 011103.