XVIII INTERNATIONAL CONFERENCE ON HYPERBOLIC PROBLEMS
THEORY, NUMERICS, APPLICATIONS
Málaga, June 20-24, 2022

Critical thresholds in the Euler-Poisson-alignment system

Manas Bhatnagar [*], Hailiang Liu [†], Changhui Tan [‡]

The talk concerns the global wellposedness of the Euler-Poisson-alignment system. This system arises from collective dynamics, and features two types of nonlocal interactions: the repulsive electric force and the alignment force. It is known that the repulsive electric force generates oscillatory solutions, which are difficult to be controlled by the nonlocal alignment force using conventional comparison principles. We construct *invariant regions* such that the solution trajectories cannot exit, and therefore obtain global wellposedness for subcritical initial data that lie in the invariant regions. Supercritical regions of initial data are also derived which leads to finite-time singularity formations. To handle the oscillation and the nonlocality, we introduce a new way to construct invariant regions piece by piece in the phase plane of a reformulation of the EPA system. We will also see results pertaining to the weakly singular alignment force case. The singularity leads to the loss of a priori bounds crucial in our analysis. The key is the construction of non-trivial invariant regions with the help of improved estimates that guarantee global wellposedness of the EPA system with weakly singular alignment interactions.

References

[1] M. Bhatnagar, H. Liu, C. Tan. Critical thresholds in the Euler-Poisson-alignment system. *ArXiv: 2111.11999*, 2021.

[*]Department of Mathematics, Iowa State University. Email: manasb@iastate.edu
[†]Department of Mathematics, Iowa State University. Email: hliu@iastate.edu
[‡]Department of Mathematics, University of South Carolina. Email: tan@math.sc.edu