

Numerical Methods for PDE-Constrained Optimization of Particle Dynamics

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There are many industrial and biological processes, such as beer brewing, nano-separation of colloids and bird flocking, which can be described by integro-PDEs. These PDEs describe the dynamics of a ‘particle’ density within a fluid bath, under the influence of diffusion, external forces, and particle interactions. They often include nonlinear, nonlocal boundary conditions. A key challenge is to optimize these types of processes, which requires tools from PDE-constrained optimization. In this talk I will introduce a numerical method to solve this class of optimal control problems, which combines pseudospectral methods and spectral elements with a sweeping algorithm. This provides a tool for the fast and accurate solution of the resulting optimality systems. Finally, some examples of current work and future industrial applications will be given.

References

- [1] Aduamoah, M., Goddard, B.D., Pearson, J.W. & Roden, J.C. *PDE-Constrained Optimization Models and Pseudospectral Methods for Multiscale Particle Dynamics*. Preprint at <https://arxiv.org/abs/2009.09850>(2020)