Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Optimization of Finite Element Simulations of Colliding, Particle-laden Flows on Unstructured Grids GRANT RYDQUIST, MAHDI ESMAILY, Cornell University — When simulating fluid systems in complex geometries, it is often necessary to discretize the system using a large number of unstructured elements to achieve accurate results. However, this can pose a number of problems when the simulation must also include Lagrangian particles. In such simulations, it is necessary to search for the element that contains a particle at each time step in order to accurately interpolate fluid properties to the location of the particle. While this operation is inexpensive for structured grids, in unstructured grids a standard implementation of this search algorithm requires $O(N_p N_{el})$ operations, and can become prohibitively expensive for fine grids with many particles. A second situation which can lead to increased computational cost in simulations with Lagrangian particles is when binary collisions between particles must be captured. In general, each particle must be checked against every other particle to check for potential collisions, resulting in $O(N_p^2)$ calculations. In this work, we present a new technique to drastically reduce the computational cost in both of these situations through an optimization problem. In both of these cases, application of this optimization problem has led to a cost that is $O(N_p)$.

Grant Rydquist
Cornell University

Date submitted: 19 Jul 2019 Electronic form version 1.4