Zhuoyuan Song* (zsong@hawaii.edu), 2540 Dole Street H302, Honolulu, HI 96822. Multi-robot swarming through fluid abstraction.

The recent advance in the modeling and control of multi-robot systems, especially mobile robot swarms or flocks, have enabled several real-world systems with practical implications. However, existing approaches often fell short of providing a means for systemic performance analysis and prediction. To this end, a multi-robot swarming approach has been proposed based on fluid abstraction to embed a natural description of the macroscopic swarm dynamics into a distributed control scheme. Robot swarms are approximately modeled as fluids by treating each agent as a “particle” of the smoothed particle hydrodynamics (SPH) approach. It can be shown that inter-agent collisions, obstacle avoidance, flocking, and flock guidance can be achieved in an elegant fashion. Nondimensional analysis can be applied to the governing equation of the swarm dynamics (i.e. discrete Navier Stokes) to reveal the mapping between flock control properties (e.g. velocity consensus) and important dimensionless quantity in fluid mechanics (e.g. Reynolds number). This multi-robot modeling and control scheme has unique advantages for mobile robots navigating within fluid mediums such as strong ocean currents and hurricanes. (Received January 29, 2019)