Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Bistability in the collective behavior of confined fish schools[1]
CHENCHEN HUANG, EVA KANSO, University of Southern California — Fish schools are examples of systems whose collective dynamics emerge from individual-level interactions. These systems are often modeled with self-propelled particles in unbounded domains subject to phenomenological behavioral rules based on visual feedback that usually neglect hydrodynamic interactions among the fish. Little is known on how geometric confinement together with flow-mediated interactions affect the collective behavior of fish. Here, we combine vision-based rules with hydrodynamic interactions in a circular domain, and we map out the different collective phases that the group of fish can achieve. We show that (1) a new collective phase emerges where the group follows the tank wall; (2) the collective phases are insensitive to the light intensity; and (3) a new bistable regime emerges in which the school intermittently switches from schooling to milling and vice-versa. We analyze the bistable regime by constructing effective potentials on the coarse-grained translational and rotational order parameters. We find that the bistable regime is sensitive to the school size and the geometric confinement. We conclude by commenting on how these techniques can be extended to study general stochastic collective dynamics.

[1]ONR:12707602

Chenchen Huang
University of Southern California

Date submitted: 03 Aug 2020 Electronic form version 1.4