Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

Emergent motion patterns of delay-coupled swarms[1] KLEMENTYNA SZWAYKOWSKA, U.S. Naval Research Laboratory, Code 6792, Plasma Physics Division, LUIS MIER-Y-TERAN-ROMERO, Department of Epidemiology, Johns Hopkins University Bloomberg School of Public Health, IRA SCHWARTZ, U.S. Naval Research Laboratory, Code 6792, Plasma Physics Division — Emergent pattern-forming behaviours of aggregates of interacting autonomous agents are a topic of great interest in complex systems research, with applications including biology, environmental monitoring, and defence. We model, and experimentally verify, pattern formation in a swarm of delay-coupled agents, using a simple but general model of agent interactions. Using mean-field dynamics, we perform a thorough analytical study of the bifurcation structure as a function of network connectivity and delay to describe the emergence of pattern formation. We show that swarm motion patterns observed for a homogeneous swarm with all-to-all communication are robust to decreasing network connectivity and to heterogeneity in the parameters governing individual agent behaviours. We perform systematic numerical studies to show where the mean-field theory deviates from simulation and experiment.

[1]This research is funded by the Office of Naval Research (ONR) (Contract No. N0001412WX20083 and NRL Base Funding Contract No. N0001414WX00023). KS holds a NRC Research Associateship Award. LMR is a post-doctoral fellow at JHU, supported by NIH.

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Date submitted: 03 Nov 2015 Electronic form version 1.4