Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

Coherent Pattern Prediction in Swarms of Delay-Coupled Agents[1] LUIS MIER-Y-TERAN-ROMERO, Johns Hopkins University/Naval Research Laboratory, ERIC FORGOSTON, Department of Mathematical Sciences, Montclair State University, IRA SCWARTZ, U.S. Naval Research Laboratory, Nonlinear Systems Dynamics Section, Plasma Physics Division — We consider a general swarm model of self-propelling particles interacting through a pairwise potential in the presence of a fixed communication time delay. Previous work has shown that swarms with communication time delays and noise may display pattern transitions that depend on the size of the coupling amplitude. We extend these results by completely unfolding the bifurcation structure of the mean field approximation. Our analysis reveals a direct correspondence between the different dynamical behaviors found in different regions of the coupling-time delay plane with the different classes of simulated coherent swarm patterns. We derive the spatio-temporal scales of the swarm structures, and also demonstrate how the complicated interplay of coupling strength, time delay, noise intensity, and choice of initial conditions can affect the swarm. In addition, when adding noise to the system, we find that for sufficiently large values of the coupling strength and/or the time delay, there is a noise intensity threshold that forces a transition of the swarm from a misaligned state into an aligned state. We show that this alignment transition exhibits hysteresis when the noise intensity is taken to be time dependent.

[1]Office of Naval Research, NIH (LMR and IBS) and NRL (EF)

Luis Mier-y-Teran-Romero
Johns Hopkins University/Naval Research Laboratory

Date submitted: 07 Nov 2012 Electronic form version 1.4