



American University of Beirut

Physics Department

Invites you to the PhD Thesis Defense entitled

***“What I have learned playing with coupled self-propelled particles:
Flocks, anti-flocks, and transitions between them”***

By

Amara Al-Sayegh

You are already late and rushing to your appointment, having gulped a shot of Abu Naji's darkest java. You meander through pedestrian traffic, cross past anxious drivers, whiz through the Main Gate, then dodge barricades of aimless students, and find your way to the promenade between orange groves and Marquand house. Lucky as you are, a flock of parakeets, which made a home out of our botanical garden (to be), cuts a greenish sliver across the sky, and lands on the cypress grove to your left. You note in passing (through it) a swarm of gnats shimmering in the setting sun.

While descending the stairs, you just have enough time to wonder: how does this all come about, the smooth flowing crowds, the flocking of birds, the swarming of gnats? Are these forms of collective behavior governed by unifying principles, and can one apprehend them through mathematical models, with insights, physical? With questions like that, might as well forget about your appointment and drop by my lecture to sample a serious attempt at dealing with similar such questions, the way a physicist, armed with computational resources, would.

Working with an agent-based model, I studied two dimensional swarms, explored emergent self-organized states at low energies, and transitions between them. My experiments identify key ingredients for any future first principles theory of such behavior. Then, I shift settings and take a deep look at leader-follower dynamics, with cone-of-vision type coupling. My work here is motivated by studies of shoals of fish in tanks. But rather than focusing on leadership behavior (which is fashionable in this field), I identify leader-avoiding states, which have as much to say about conditions of effective leadership, as they do about robots in formation, and/or paradoxical regimes of human behavior in confinement.

Committee:

Prof. Khalil Bitar, AUB (Chair)

Prof. Leounid Klushin and Jihad Touma, AUB (Co-advisors)

Prof. Kolbjörn Tunström, Chalmers University of Technology, Sweden (Committee member)

Dr. Sara Najem, Graduate Aerospace Laboratories (GALCIT), Caltech, USA (Committee member)

Date: Friday, May 6, 2016

Time: 3:00 p.m.

Place: SLH

(All are welcome!)