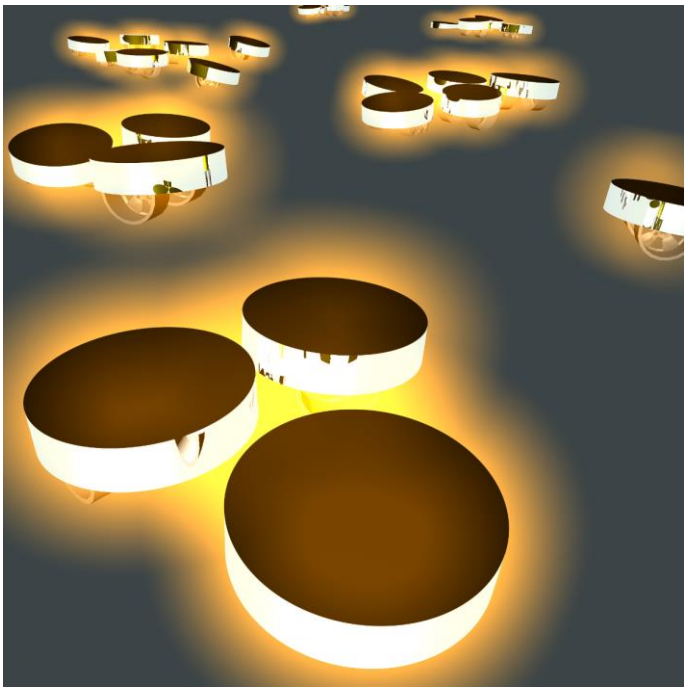
TIFX04-22-16
Collective dynamics of autonomous robots in a complex environment



Bakgrund: The behavior and interaction of autonomous individuals capable of sensing and reacting to their environment play a critical role in many natural phenomena and artificial systems. For example, animals organize into flocks, swarms, and colonies, and we would like to understand how their collective behaviors are coordinated. Groups of autonomous robots could potentially be organized in similar ways. Furthermore, often such systems of autonomous agents have to interact with a complex environment, where for example obstacles are present. Current research is now trying to understand and engineer these behaviors.

Problembeskrivning: This project aims at studying the collective motions and behaviors of a systems of autonomous agents in a complex environment. It will in particular consider how systems of simple agents (where each agent follows very simple rules, senses only its immediate surroundings, and directly interacts only with nearby agents, without having any knowledge of an overall plan) can lead to very complex behaviors.

Arbetssätt: The project will consist both simulations with MatLab and experiments realized with Elisa-3 microrobots. The thesis and presentation can be in Swedish.

Gruppstorlek: 6 studenter.

Målgrupp: F, GU-fysik, TM, E, Z, D, IT eller motsvarande.

Litteraturtips: (1) Viswanathan, G. M., Da Luz, M. G., Raposo, E. P., & Stanley, H. E. (2011). *The physics of foraging: an introduction to random searches and biological encounters*. Cambridge University Press. (2) Mijalkov, M., McDaniel, A., Wehr, J., & Volpe, G. (2016). Engineering sensorial delay to control phototaxis and emergent collective behaviors. *Physical Review X*, *6*(1), 011008. (3) Leyman, M., Ogemark, F., Wehr, J., & Volpe, G. (2018). Tuning phototactic robots with sensorial delays. *Physical Review E* 98(26), 052606. (4) http://www.gctronic.com/doc/index.php/Elisa-3

Handledare: Giovanni Volpe, giovanni.volpe@physics.gu.se