Jonah Galeota-Sprung, Davidson College, Davidson, NC, USA
Andrew Lantz, Davidson College, Davidson, NC, USA
Tucker Whitesides, Davidson College, Davidson, NC, USA
Laurie Heyer, Davidson College, Davidson, NC, USA

Exploring Emergent Behavior in Oscillatory Systems Using Agent-Based Modeling

The field of agent-based modeling is a relatively young field of research in which researchers define sets of agents and sets of rules that control their interactions with each other and the environment. The researcher then takes on the role of observer, watching and analyzing the behavior that emerges in the system. Because of their emphasis on emergent properties arising from simple interactions, agent-based models (ABM's) are well suited to the modeling of complex biological systems such as gene networks.

Our group is engineering intercellular communication systems in bacteria, thereby laying a foundation for ABM's in which the agents are living cells. To validate our approach, we searched for a system that incorporated different methods of communication and produced emergent behavior. We chose the "biopixel" system, recently engineered at UCSD, due to its synthetic design that employed quorum sensing and gas-phase communication to synchronize global oscillation. The biopixels use quorum sensing within colonies to achieve oscillation, and gas-phase communication between pixels to synchronize oscillation between neighboring pixels. We model the biopixel system using the free ABM software package NetLogo, and suggest ways that living ABM's could be applied.