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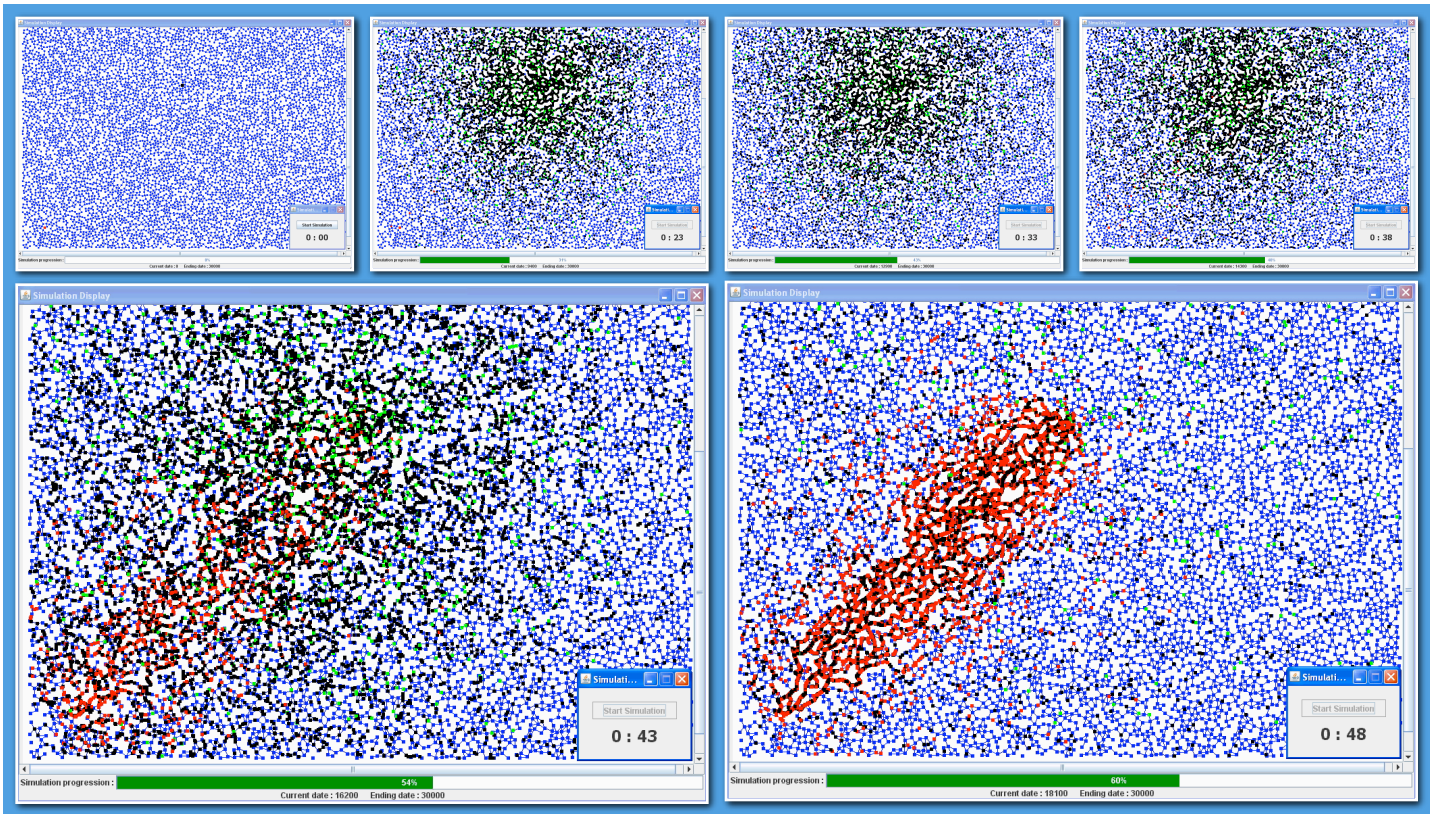
complex systems

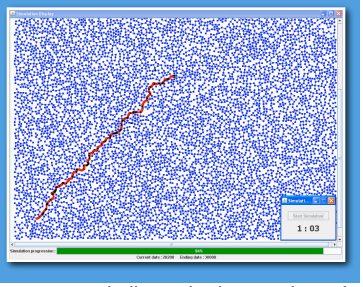
IMAGE OF THE MONTH

June

Phase Transitions in Agent-Based Ant Colony Optimization Graph Search



Large graphs can be searched using an agent-based technique called Ant Colony Optimization. Software agents simulate the stochastic trail marking used by biological ants for collaborative food foraging. The top images show random foraging; those at bottom show the transition to social foraging, which results in a near optimal path between the nest and the food source.



Animation available at: www.itl.nist.gov/ITLPrograms/ComplexSystems/

Abstract—We are developing a distributed Complex Systems test bed for large-scale agent based simulation. One of our test cases is the so-called Ant Colony Optimization (ACO) simulation in which simple agents conduct a stochastic search for food using pheromones to mark successful trails. Biological ant colonies have been shown a phase transition from purely random to social (and optimal) search patterns with colony size. Our distributed test bed allows us to show a similar phase transition in large-scale simulations. Our method of parallelization provides performance improvements nearly linear in the number of distributed processors employed.

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Information Technology Laboratory

NIST
National Institute of Standards and Technology
U.S. Department of Commerce

2008

The Complex Systems Program is part of the National Institute of Standards and Technology's Information Technology Laboratory. Complex Systems are composed of large interrelated, interacting entities which taken together, exhibit macroscopic behavior which is not predictable by examination of the individual entities. The Complex Systems program seeks to understand the fundamental science of these systems and develop rigorous descriptions (analytic, statistical, or semantic) that enable prediction and control of their behavior.

Program information at: `www.itl.nist.gov/ITLPrograms/ComplexSystems`