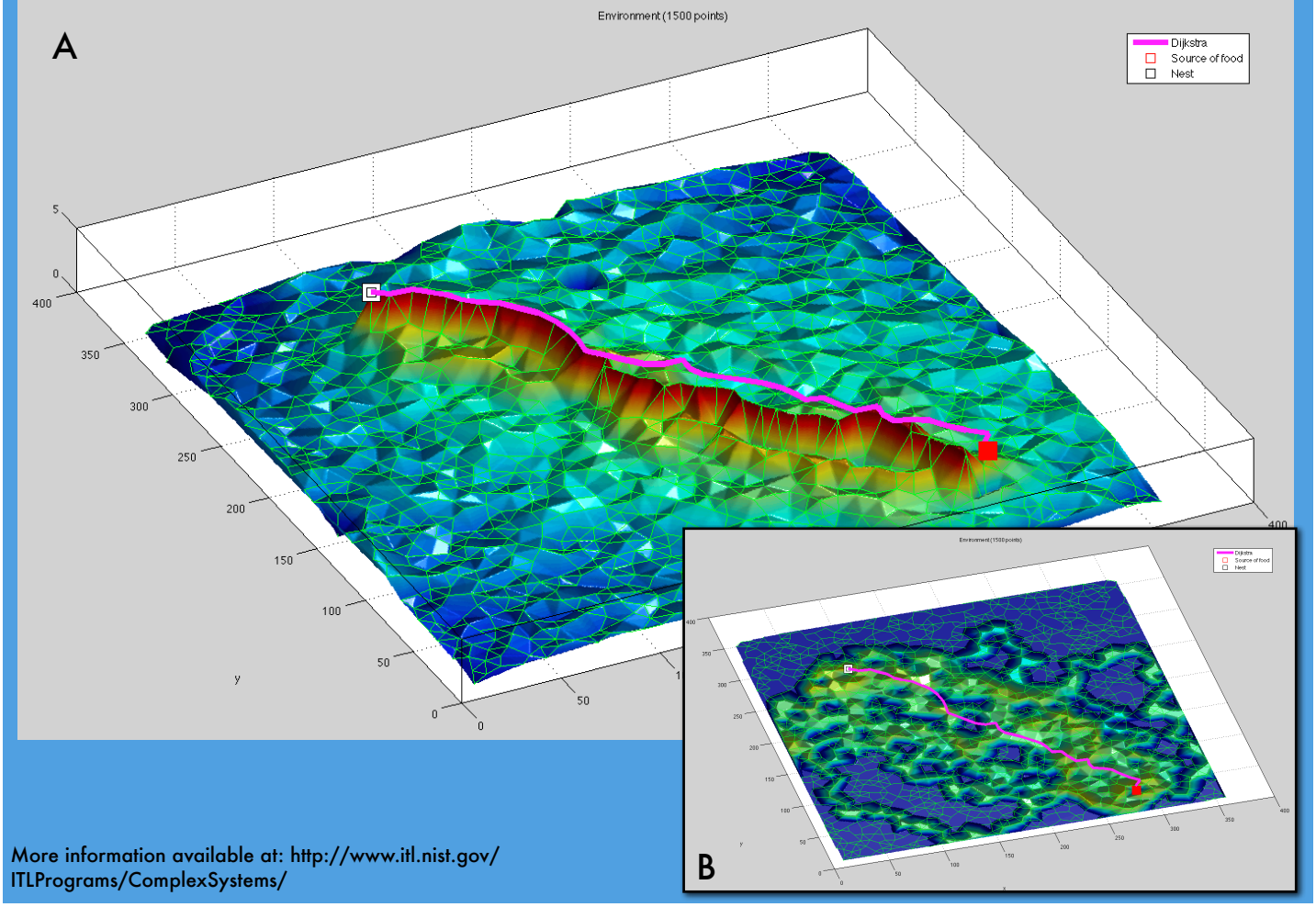
Imad Hamchi
Mathieu Hoarau
Vincent Stanford

complex systems

IMAGE OF THE MONTH

July

Phase Transition in Cooperative Agent-based Digital Ant Colony Optimization



More information available at: http://www.itl.nist.gov/ITLPrograms/ComplexSystems/

The figures show a graph search problem and distribution of ant foragers for two populations. One is large enough for the phase transition to collaborative search to occur, and one is too small.

The size of ant forager populations relative to the size of the search space determines if the ant foragers will collaborate to find efficient solutions (image A), or explore the search space independently and stochastically (image B). Note the high degree of concentration of pheromones on a path near the best path in image A where there is a sufficient forager population for the phase transition to collaborative foraging. Note also the more diffuse pheromone concentration in image B.

This is an instance of Complex System Phase transitions, or emergent behavior in a system of many simple interacting elements.

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Information Technology Laboratory

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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.

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