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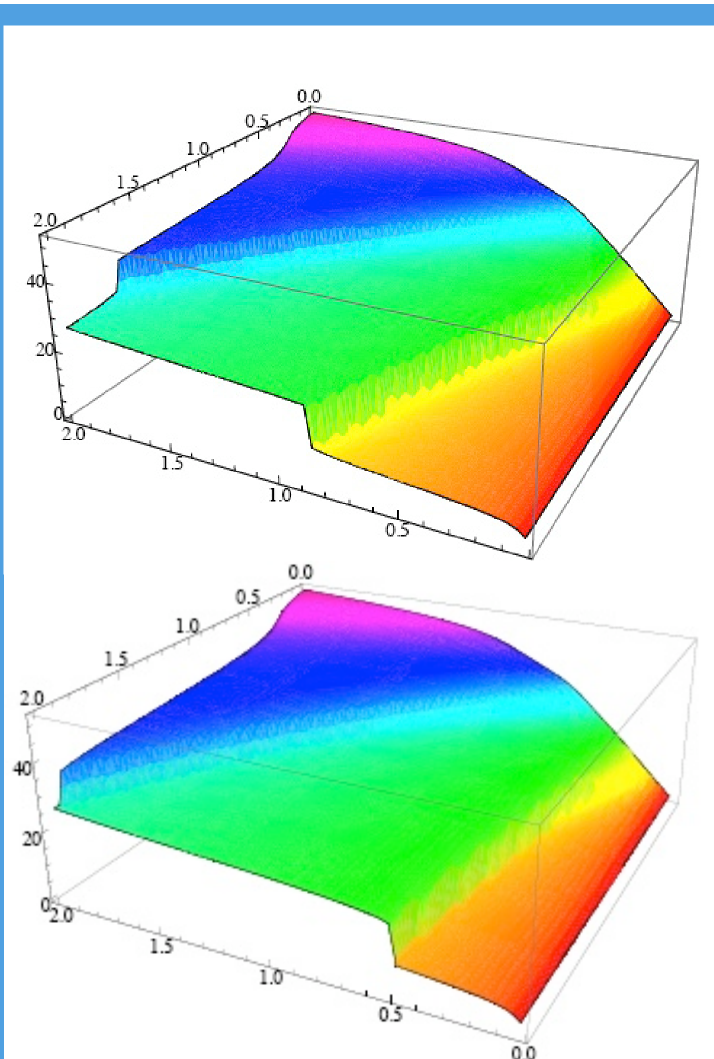
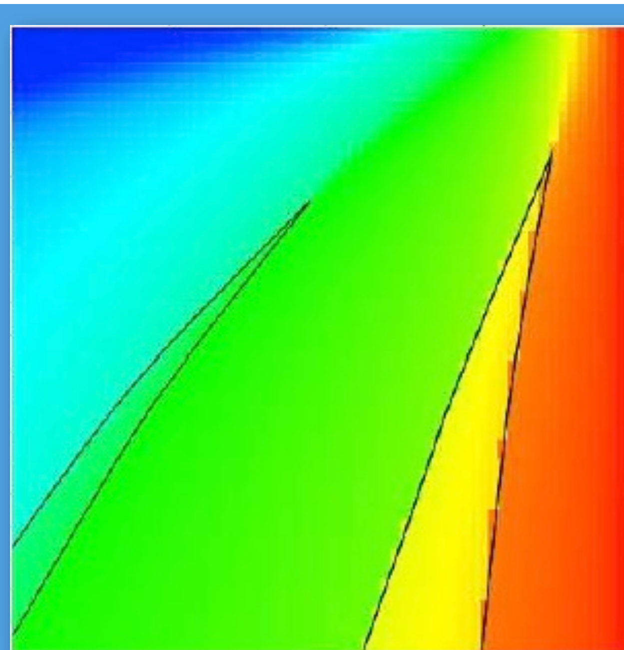
complex systems

IMAGE OF THE MONTH

March

Toward Understanding of Metastability in Large-Scale Loss Networks with Mobile Users: Emergence and Implications for Performance





Convex hulls (left images) of the lower and upper branches respectively of the equilibrium manifold for service class 1. Phase diagram (above) constructed by projecting the equilibrium manifold by averaging. Regions outlined in black represent areas of metastability (coexistence).

From D. Genin, V. Marbukh, *Toward Understanding of Metastability in Large-Scale Loss Networks with Mobile Users: Emergence and Implications for Performance* Journal of Complex Systems, Vol. XX, No. Y, May 2008

Abstract—We investigate the behavior of a distributed server loss network with mobile users.While theMarkov model provides an accurate "microscopic" model of the network behavior, the dimension of this model grows exponentially with the number of nodes precluding solution of the corresponding Kolmogorov equations. Dimension of the mean-field approximation model grows only linearly with the number of nodes making this approximation computationally tractable. Through numerical analysis we show that the equilibrium state of the corresponding mean-field model bifurcates under increasing network load. These multiple solutions are interpreted as describing network's metastable states associated with phase transitions. We discuss performance characteristics of the network and construct a representative phase diagram.

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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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