Cornell Dynamical Systems Seminar

www.math.cornell.edu/~dynsem/

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## *How can I say that a "toy" model reminds me of observations? A dynamical systems perspective of comparing non-conjugate systems*

We address a fundamental modeling issue in science as related to the field of dynamical systems: when is a model of a physical system a "good" representation? Conjugacy provides a means to define if two systems are dynamically equivalent; it is the central equivalence relationship in the field of dynamical systems. However, it cannot cope with systems which are not dynamically identical. What then to do with the common scientific practice of modeling, whereby we build heuristic and phenomenological models which "remind" us of the true system?

We develop mathematical technology to decide when dynamics of a toy model are like dynamics of the physical system. When applied to non-conjugate dynamical systems, we show that a fixed point iteration scheme yields a limit point, that is a function we call a "commuter": a non- homeomorphic change of coordinates translating between dissimilar systems. This translation is true to the concepts of dynamical systems in that it matches systems within the language of their orbit structures. We introduce methods to compare nonequivalent systems by quantifying a defect of the commuter function's failure to be a homeomorphism - an approach that better respects the dynamics than any traditional comparisons based on normed linear spaces. Our discussion addresses a fundamental issue: how does one make principled statements of the degree to which a "toy model" might be representative of a more complicated system. We highlight our methods with a lower-ordered models of more complicated systems.

Friday, October 29, 2010, 2:15 pm, in 205 Malott Hall