

Double categories of open dynamical systems

David Jaz Myers

Johns Hopkins University, USA

2 June 2020 (Tuesday), 16:00 (Lisbon time) · Zoom

Abstract

A dynamical system consists of a notion of how things may be, and a notion of how things may change, given how they are. There are many sorts of dynamical systems --- discrete, continuous, probabilistic, non-deterministic --- and the dynamics often depend on parameters which themselves may be governed by dynamical laws. In this talk, we will see a general construction of double categories of such open dynamical systems from the data of an indexed category of spaces of how things may change, indexed over a category of spaces of how things may be. The fact that such dynamical systems naturally form double categories rather than just categories reflects the two general sorts of functional relations that dynamical systems may have. First, we have "covariant morphisms" which include the subsystem inclusions, the quotient projections, and the trajectories. And second we have the "contravariant morphisms" which include wiring diagrams that allow component systems to be 'wired together' into complex systems, and hierarchical planners that allow for coordination of systems across scale. We will see how these sorts of morphisms arise naturally from double categorical constructions.