Colloquium

March 22, 4:05 p.m. (9th Period)
(in the Atrium)

Speaker: Luke Morris

Title: Abstraction and Composition in Modeling and Simulation

Abstract: We approach the representation and assembly of multiphysics problems as a synthetic differential geometry problem and use de Rahm complexes to model partial differential equations, resulting in the Decapodes.jl, a software library for representing, composing, and solving partial differential equations.
These diagrammatic representations provide an intuitive interface for specifying the relationships between variables in a system of equations, a method for composing systems equations into a multiphysics model using an operad of wiring diagrams, and an algorithm for deriving solvers using directed hypergraphs. This approach yields a method of generating executable systems from these diagrams using operators from the Discrete Exterior Calculus on a simplicial set. We demonstrate the feasibility of a synthetic approach to differential geometry as a foundation for numerical multiphysics simulation and identify areas for future development, potentially via implementation of the finite-element exterior calculus.