

Pontificia Universidad Católica del Perú
Escuela de Posgrado & Sección Matemáticas



Seminario de Matemática

Data Driven Discovery in Hamiltonian and
Open Quantum Systems

Jimmie Adriaola¹

Abstract: The first part of this talk will be about automated discovery of integrability in Hamiltonian dynamical systems. Integrability is a mathematically rich topic and often the starting point for analyzing more complex, nonintegrable equations. However, it is difficult to even recognize if a given system is integrable before investing effort into studying it. Therefore, we formulate the automated discovery of integrability in dynamical systems, specifically as a symbolic regression problem. Our approach is tested on a variety of systems ranging from nonlinear oscillators to canonical Hamiltonian PDEs. We test robustness of the framework against nonintegrable perturbations, and, in all examples, reliably confirm or deny integrability. Moreover, using a thresholded regularization to promote sparsity, we recover expected and discover new Lax pairs despite wide hypotheses on the operators. The second part of the talk will focus on data-driven discovery of Volterra integral equations that model non-Markovian dynamics typically present in open quantum systems, an important class of equations that can be used to model the dynamics of qubits interacting with environments that have a large number of degrees of freedom. Time permitting, we will discuss future directions for adapting our frameworks toward further automated discoveries in mathematical physics and their potential to build reduced-order models and digital twins of complex physical scenarios.

Fecha: Lunes 4 de agosto de 2025

Hora: 14:00 - 15:00 horas

Lugar: Auditorio de Matemáticas.

¹Jimmie Adriaola is an NSF Mathematical Physical Sciences ASCEND postdoctoral fellow and Presidential Postdoctoral Scholar at the School of Mathematical and Statistical Sciences in Arizona State University. He was previously a visiting assistant professor at Southern Methodist University, was a postdoctoral scholar at the University of California, Santa Barbara, and completed his Ph.D. in mathematical sciences at the New Jersey Institute of Technology. His main research interests involve mathematical foundations of data science and automated discovery of mathematics.