ACMS Applied Math Seminar

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154 Hurley Hall
3:30 PM – 4:30 PM

Scientific Machine Learning for Dynamical Systems Identification

The advancement of Physics-Informed Machine Learning (PIML) methods will empower scientists to swiftly and effectively address unresolved and complex physics problems across various applied sciences, including engineering, physics, chemistry, biology, and neuroscience. This talk will present a set of scientific machine learning algorithms distinguished by their exceptional computational speed, reliability, robustness, and adaptability, enhancing their efficiency and versatility in a wide range of applications of dynamical systems with time-series data. The problems tackled by these algorithms can be categorized into three scenarios based on the quantity of two ingredients: the level of physical knowledge and the availability of observable data. 1. No available data, but well-established physics: In this case, a numerical method is required to solve the forward problem, which is driven by physics and typically modeled by a differential equation. 2. Limited data with partial physics knowledge: This is the most common scenario in engineering applications, where PIML methods can effectively integrate the available data with partially known physics models for parameter discovery. 3. Available observed data with unknown physics: In this data-driven scenario, the physics governing the phenomena is entirely unknown, necessitating the learning of the underlying physical principles from the data. The PIML algorithms discussed in this talk are designed to address all three scenarios, merging machine learning techniques to effectively tackle complex nonlinear dynamical systems.