

**Discovery of State Variables Hidden in Experimental Data**

**Kuang HUANG**

**Department of Mathematics, The Chinese University of Hong Kong, Hong Kong SAR, P. R. China**

**Email: [kuanghuang@cuhk.edu.hk](mailto:kuanghuang@cuhk.edu.hk)**

Physical laws can be described as relationships between state variables that give a complete and non-redundant description of the relevant dynamical systems. Most data-driven methods for modeling physical phenomena assume that observed data streams already correspond to given state variables. However, despite the prevalence of computing power and AI, the process of identifying a set of state variables themselves from experiment data has resisted automation. We propose a framework for determining how many state variables an observed system is likely to have, and what these variables might be, directly from video streams. We demonstrate the effectiveness of this approach using video recordings of a variety of dynamical systems, ranging from elastic double pendulum to fire flames.