The Lattice Method for Finding Conserved Quantities of Dynamical Systems

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Dynamical systems can describe many real-life phenomena from physics, chemistry, or biology, and have applications in engineering, robotics and even machine learning. Despite their wide usage, exact solutions in general are difficult to find and to understand these systems, one often resorts to either numerical approximations of their solutions or analysis of their qualitative properties. In our research work, we focus on the latter by studying invariants of dynamical systems. Specifically, we study the existence of time-dependent conserved quantities called "Darboux First Integrals" for polynomial dynamical systems. Moreover, we introduced a novel algorithmic approach called the "Lattice Method" to deduce the existence or non-existence for Darboux First Integrals of any polynomial order. In this talk, we will introduce these ideas and showcase examples with non-trivial time-dependent conserved quantities. We will also discuss some applications to chaotic systems.

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