ASelf-adjoint Operators, Integrating Factors and Neural Networks Applied to the Study of Nonlinear ODEs

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Abstract

This presentation will go over the solving of ordinary differential equations (ODEs) specifically Ricatti ODEs. We show how to solve Ricatti ODEs through theoretical methods such as integrating factor and we also solve Ricatti ODEs with practical applications such as physics-informed neural networks (PINNS). We focused on Ricatti equations as they are in many applications such as the Korteweg De Vries equation, the Scrhodinger equation and many more. Riccati equations are a non inear ODE so we establish methods to help reduce their complexity. Some of these methods are finding a second order linear ODE that is related to the Riccati equation as well as exploring the self-adjoint property of the Riccati equation to reduce or remove the nonlinear aspect. Lastly we wanted to compare these theoretical methods with practicals methods such as PINNS to help bridge the gap between the classical analysis and modern computational techniques.

Keywords: Differential Equations, Ricatti Equations, Integrating Factor, Adjoint, Self-adjoint, Physics-Informed Neural Networks

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