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PHYSICS INFORMED DATA-DRIVEN SYSTEM IDENTIFICATION OF NON-LINEAR SYSTEMS FOR SPACE EXPLORATION.

Abstract

Humans have long been fascinated by space exploration, and designing and operating successful spacecraft calls for a solid foundation in physics and engineering. Physics is essential to space exploration because it helps us understand how celestial bodies behave and helps us create spacecraft that can safely navigate through the challenging conditions of space. This involves the advancement of technologies necessary for the success of space operations, such as propulsion systems, guidance systems, and materials science. For the purpose of identifying non-linear systems, such as those engaged in space exploration, data-driven approaches are gaining popularity. These methods make predictions about future behavior by using massive quantities of data to extract patterns and relationships between inputs and outputs. To make sure that the resulting predictions are precise and trustworthy, physics-based models must be incorporated into these data-driven methods. A damped pendulum can be used to simulate how a spacecraft or robotic arm will act in a microgravity setting. A pendulum's motion is influenced by damping forces, which are comparable to the drag or friction that satellites encounter in the atmosphere. Researchers can learn more about the dynamics of spacecraft and create more effective control systems by observing the behavior of a damped pendulum, ensuring that they function easily and effectively. Physics informed neural network has received massive attention in the field of science and engineering. Physics Informed Neural Network (pinn) are neural networks (nn) that encodes model equations, like Partial differential equations (pde), as a component of the neural network (Cuomo et al (2022)). Using neural networks as surrogate models that have been trained using data gathered at a combination of input and output values is fundamentally different from pinns. Pinn has a wide range of potential applications in many fields due to its ability to incorporate physical constraints and laws into the training process of the neural network. Due to its simplicity, PINNs have helped advance several branches of space exploration technology.