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ADVANCES IN KOOPMAN OPERATOR METHODS FOR ASTRODYNAMICS APPLICATIONS

Abstract

The Koopman operator, a powerful mathematical tool, has emerged as a promising framework for analyzing and solving complex problems in nonlinear dynamics, offering a data-driven approach to understanding and predicting behavior of systems. This paper provides a comprehensive review of the recent advancements and applications of the Koopman operator theory in astrodynamics, categorizing and analyzing relevant studies and focusing on diverse applications within the field, such as attitude dynamics, orbital mechanics and space missions. By examining case studies and applications, the efficacy of the Koopman operator approach in enhancing the predictive accuracy, computational efficiency, and robustness of astrodynamics solutions as well as its integration with other mathematical tools such as machine learning are discussed. The review also addresses the current limitations and outlines future directions of applying Koopman operator theory in astrodynamics, emphasizing the importance of interdisciplinary collaboration and experimental validation to further advance the field.