Paradigm Shift in Propulsion System Development: The Role and Potential of AI

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Abstract

The development of propulsion systems is currently experiencing a paradigm shift, driven by the integration of artificial intelligence (AI) methodologies into traditionally physics-based engineering workflows. This study examines the emerging role and transformative potential of AI in advancing predictive modeling and design optimization for propulsion systems. To illustrate these advances, a series of studies with ML techniques will be presented: (1) the data-driven prediction of three-dimensional spray morphology (2) ML-based modeling of injection rate dynamics and (3) the application of ML frameworks to enhance CFD simulation. The study aims to provide a critical perspective on the methodological integration of AI into propulsion system research, outlining both the opportunities and the inherent challenges. By situating recent advancements within the broader context of engineering innovation, the discussion seeks to illuminate the implications of this paradigm shift for future propulsion system design and analysis.