Message from the Guest Editors of the Special Issue on Applications of Artificial Intelligence in Aerospace Engineering

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Dear authors and readers,

Artificial intelligence (AI) has recently found many new applications in aerospace engineering, which range from long-term scheduling of space telescope observations to science planning for the Rosetta mission, from AI-based “astronaut assistant” in International Space Station to AI instrument equipped in the Mars rover Curiosity. The current perception is that methods and techniques developed within the AI research field have the potential to revolutionize almost every aspect of space exploration. It is thus very important for aerospace engineers to monitor the advances on the state-of-the-art methods available in the AI field and be aware of their proposed applications, owing to which, this special issue is organized.

There are 7 papers collected in this special issue, which cover a wide range of areas. A survey on AI trends that have emerged in spacecraft guidance dynamics and control is made by Izzo, Märtens, and Pan. Smet, Scheeres, and Parker demonstrate how artificial neural networks can be used to alleviate common problems encountered when creating a large database of Poincaré map responses. Peng and Bai compare the performance of utilizing three machine learning algorithms, support vector machine, artificial neural network, and Gaussian processes, to improve orbit prediction accuracy. Tang and Hauser propose a data-driven framework to solve nonlinear optimal control problems, which has the ability to obtain globally optimal solutions with high likelihood and in milliseconds. Tailor and Izzo introduce a supervised imitation learning approach to design highly accurate and real time optimal controls. Cheng, Wang, and Jiang apply deep reinforcement learning methods to provide good initial guesses for the indirect method, which is utilized to generate optimal trajectories for Moon landing missions. Besides, Märtens, Izzo, Krzic, and Cox study the temporal multi-image super-resolution by using convolutional neural networks, based on the low- and high-resolution optical images collected from ESA’s PROBA-V Earth observation satellite.

This special issue intends to bring recognition to the latest applications of AI in aerospace engineering. Even with the great strides made in recent years, much remains a work in progress, and we hope that this effort will further stimulate research interest in this area.

Finally, we would like to thank all the contributors to this special issue.

Sincerely,

Dario Izzo

Marcus Märtens

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