Carleton University
Department of Mechanical and Aerospace Engineering

Graduate Seminar Series

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Guardian Maps-Based Adaptive and Robust Control of Spacecraft Formation Flying

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Abstract

a single parameter guardian maps-based adaptive control system for spacecraft formation flying is developed. When compared with traditional vehicles, the dynamics of spacecraft features larger non-linearities, tighter coupling and stronger uncertainty. Specifically, as the eccentricity of an orbit increases, the non-linearities become even more apparent. The proposed approach addresses the problem of controlling a chaser spacecraft such that it tracks a desired relative trajectory with respect to the target spacecraft, regardless of disturbances. Making use of Guardian Maps theory, a standard proportional-derivative controller can be made adaptive such that the desired closed-loop stability of the system is guaranteed throughout the orbit. Simulation results for a projected circular formation example are provided to illustrate the increased performance and robustness of the proposed adaptive controller compared to a conventional non-adaptive linear quadratic regulator control law.

Bio

Mr. Yazan Chihabi obtained an undergraduate degree in Aerospace Engineering in April 2019. Having joined the Spacecraft Robotics and Control Laboratory in May, 2018, he has completed works on the analytical propagation of spacecraft relative motion in perturbed eccentric orbits and the development of a simple terminal-point, or back-propagation, guidance algorithm for spacecraft formation flying. This sparked a passion for research, particularly within the field of autonomous spacecraft and robotics which lead him to pursue his masters then fast-tracked into Ph.D. His interests include but are not limited to: autonomous guidance, navigation and control of spacecraft formation flying, rendezvous and proximity operations. Also, he is always keen on learning new developments in the fields of computer science, machine learning, and computer hardware/electronics with specific application to aerospace and autonomous spacecraft.