Carleton University

Department of Mechanical and Aerospace Engineering

Graduate Webinar Series

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Real-Time Autonomous Model Predictive Control of Spacecraft Rendezvous and Docking with Moving Obstacles

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Abstract

Autonomous rendezvous and docking, whereby two spacecraft come into close proximity and subsequently make mechanical contact, is used for on-orbit servicing missions. The safety of these missions is endangered by space debris and other hazards that pose a threat for collisions. The guidance algorithm onboard a spacecraft is responsible for planning a safe path to a target spacecraft and must actively avoid these hazards for the success of the mission. This research presents a real-time optimal guidance algorithm for autonomous path-planning with moving obstacles based upon the Model Predictive Control framework. Numerical simulations are completed in two- and three-dimensions to prove the functionality of the algorithm, and experiments using Carleton University's Spacecraft Proximity Operations Testbed validate the real-time collision avoidance capabilities of the algorithm. The experiments are, to the best of the author's knowledge, the first to demonstrate the moving obstacle avoidance capabilities of a Model Predictive Controller for spacecraft rendezvous and docking.

COURTNEY BASHNICK is a Ph.D. student in the Department of Mechanical and Aerospace Engineering and member of the Spacecraft Robotics and Control Laboratory at Carleton University. She received her B.Sc. (Honours) degree with a double major in Astrophysics and Physics at the University of Calgary in 2020 and was awarded the Venkatesan Silver Medallion for achieving the highest academic standing in the Department of Physics and Astronomy. She received her M.A.Sc. degree in Aerospace Engineering from Carleton University in 2022 where she was awarded a Senate Medal for her outstanding academic achievements.