

Interplanetary Navigation with Images of Celestial Bodies

Friday, March 26, 15:00-16:00 HST

Zoom link: <https://hawaii.zoom.us/j/93358887540>

SUMMARY

Of all the instruments commonly flown on exploration spacecraft, few are as flexible as the camera in the breadth of science and engineering problems it can address. This flexibility, combined with the relatively low cost of modern digital cameras, has led to these sensors being a part of nearly every contemporary planetary science mission. Therefore, with a focus on lunar exploration, we will discuss the role of camera images for spacecraft navigation in both cislunar space and low lunar orbit. These discussions will uncover new insights for horizon-based optical navigation (OPNAV) and crater-based terrain relative navigation (TRN). The geometry of both problems may be well-modeled by the action of a projective camera on a quadric surface, thus permitting elegant closed-form solutions that outperform older techniques. Moreover, in the case of craters, these ideas may be combined with invariant theory to create the first mathematically rigorous method for the lost-in-space identification of non-coplanar crater patterns on the lunar surface. Our theoretical results will be illustrated by showing performance on past flight data.

Speaker: John Christian, MANE, Rensselaer Polytechnic Institute

Dr. John Christian is an internationally-known expert in spacecraft navigation, astrodynamics, and space science. He is presently an Associate Professor in the Department of Mechanical, Aerospace, and Nuclear Engineering (MANE) at Rensselaer Polytechnic Institute (RPI), where he also directs the Sensing, Estimation, and Automation Laboratory (SEAL). Prior to his position at RPI, Dr. Christian was on the faculty at West Virginia University. Before joining academia, he worked as an engineer in the Guidance, Navigation, and Control (GNC) Autonomous Flight Systems Branch at the NASA Johnson Space Center. Dr. Christian has extensive experience supporting NASA space science and human exploration missions. He is a NASA Innovative Advanced Concepts (NIAC) Fellow and the recipient of an Air Force Office of Scientific Research (AFOSR) Young Investigator Program (YIP) award. Dr. Christian is an AIAA Associate Fellow and an associate editor of the AIAA Journal of Spacecraft and Rockets. He is also a member of the AAS Space Flight Mechanics Committee. He holds a Ph.D. in aerospace engineering from The University of Texas at Austin and a M.S. and B.S. in aerospace engineering from the Georgia Institute of Technology.