

Fall 2019 Colloquium

Department of Physics & Astronomy, TAMU-Commerce

Oct 17, Thursday, 4-5 PM in Science Building 127

(coffee and cookies will be served at 3:50 PM)

Astrodynamics, Satellite Navigation

Autonomous Lost-In-Space Cubesat Navigation

Mr. Andrew Dahir

University of Colorado Boulder



A Texas A&M University-Commerce alumnus, Andrew graduated in 2013 with a dual major in mathematics and physics with an astronomy minor. Andrew is currently a PhD student working under Dr. Scott Palo and Dr. Daniel Kubitschek in the Ann and H. J. Smead Department of Aerospace Engineering Sciences focusing on Astrodynamics and Satellite Navigation. He is part of the satellite testing and integration laboratory working on small satellites under Dr. Palo and his PhD research focus is on Deep Space Autonomous Cubesat Navigation in conjunction with NASA JPL. Andrew has directly worked on 5 small satellites and advised on 23 others while at Boulder and will begin work as a systems engineer at MIT

Lincoln Lab in January. He currently holds 4 world records in indoor rock climbing which were all broken at the Texas A&M University-Commerce climbing wall.

Abstract: Autonomous navigation in the satellite world is at best, a semi-autonomous solution. There is no system that exists currently that requires no outside presence or a priori state to get a navigation solution. As spacecraft become more numerous, the need for truly autonomous navigation becomes a greater necessity for deep space travel as communication resources become limited. When spacecraft are in deep space, communication times between a satellite and the Earth can be prohibitive and ride-sharing opportunities as well as on-board faults can leave the spacecraft without time information. This approach uses optical observations of available planets and corresponding celestial satellites (for interplanetary operations) to initially recover the approximate time and state. These observations are then followed by precise, filter-based determination of time, position and velocity from the chosen optical beacons available in interplanetary spaceflight. The innovation of this approach is to use artificial satellites and celestial bodies periodicity to initially determine time. This capability is analogous to that of advanced star trackers that can initialize themselves by identifying any star field in the celestial sphere. Being able to quickly and autonomously recover time and position from an environment with no Earth contact will advance mission safety and automation from current methods which require an Earth contact. The impact of this concept crosses both human (full loss of communication scenario) and robotic (autonomous recovery from onboard fault) exploration applications, where some form of spacecraft-to-ground communication is required to establish approximates for time and position. In both cases, the current state-of-the-art navigation systems require some knowledge of time and some approximate position to initialize the estimation process before the mission objectives can be obtained. While the solution is applicable to a wide range of missions, small satellites used for solar system exploration will be the focus as small satellite solutions can then be scaled to larger spacecraft.