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NASA SEXTANT MISSION OPERATIONS ARCHITECTURE

Abstract

The Station Explorer for X-Ray Timing and Navigation (SEXTANT) mission is a technology demonstration enhancement to the Neutron Star Interior Composition Explorer (NICER) mission, a NASA Astrophysics Explorer Mission of Opportunity to the International Space Station (ISS) that was launched in June of 2017. The NICER instrument is a precision pointing X-ray telescope that provides measurements of neutron stars, which the SEXTANT mission uses to perform autonomous onboard X-ray Pulsar Navigation (XNAV) by using milli-second pulsars (MSPs), a category of neutron stars, as timing sources for navigation. By comparing the detected time of arrival of X-ray photons to a reference of expected pulsar lightcurve timing models, one can infer a range and range rate measurement based on light time delay. Since both timing and orientation information comes from a celestial source, this technology could provide a GPS-like navigation capability available throughout our Solar System and beyond. Applications that XNAV can support include outer planet and interstellar missions, manned missions, libration orbit missions, and current infrastructure such as the Deep Space Network (DSN).

The SEXTANT team successfully completed a first demonstration of in-space and autonomous XNAV in November 2017. NICER and SEXTANT have separate teams, with NICER being the primary team with its own science objectives. Operational modes for both missions must have concurrent and independent components as well as an integrated ground system. Within this joint mission profile, SEXTANT operations requires an infrastructure and cadence that is flexible to handle concurrent science operations

from the NICER team, independent autonomous navigation demonstrations, and events within the extensive ISS operations environment. This paper first details the infrastructure implemented and its concept of operations. It then describes the operations for the SEXTANT demonstration and lessons learned.