DISCUSSION CONCLUDING AAS 11-674

Dennis McCarthy remarked that a certain level of permissible inaccuracy exists whenever UTC is used as a surrogate for UT1. He asked if there was a minimum threshold for accuracy established for the systems familiar to Mark Storz. Storz responded that error tolerances would likely be system-dependent. He noted that the field-of-view constraints on space-surveillance sensors might provide one example: for target acquisition, a sensor with a smaller field of view requires more accurate pointing. McCarthy asked if a numerical specification could be cited; Storz explained by citing the US Space Surveillance Network (SSN) as an example. He noted that these varied tracking systems make recurring observations of orbiting space objects because the orbital behavior cannot be predicted perfectly. These systems rely on the *Simplified General Perturbations Theory #4* (SGP4). This theory, and the entire network, assumes that the wall clock time is a measure of Earth rotation to predict where objects will appear within the field of regard of each sensor. Another process likely affected by discontinuing leap seconds is *observation association*; this is the task of tagging observations of space objects taken relative to the terrestrial frame to the predicted ephemerides from known orbits relative to a celestial frame. If the relationship between the terrestrial frame and celestial frame becomes too inaccurate, there is a risk of tagging the observation to the wrong object, or not tagging the observation at all and thus treating the object as an uncorrelated target.

McCarthy replied that if "one second seems to be okay," then what level of discrepancy would cause operational issues or other adverse reactions? Storz speculated that higher frequency radars such as X-band might start having issues as soon as five years out, but also noted that the issue has not been studied thus far and would need to be investigated. He also noted that optical trackers such as Ground-based Electro-Optical Deep Space Surveillance (GEODSS) telescopes have relatively narrow fields of view. GEODSS telescopes use reference stars to accurately calibrate the field of view in right ascension and declination. However, if Earth orientation angle is computed incorrectly or inaccurately, then the computed right ascension and declination of the space object will be erroneous and potentially outside the telescope's field of view. Based on Storz's comments, McCarthy deduced that space surveillance systems may start having operational difficulties by about 2030. Storz clarified that some operational failures are to be anticipated much sooner because of software that is constrained to assume the |UT1-UTC| is limited to 0.9 seconds.

McCarthy asked if some space-based sensors might self-calibrate their orientation relative to space using star sensors. Storz said that star calibration may be used to calibrate the orientation of gimbal-tracking encoders relative to an inertial frame, but the predicted surface target positioning will still be incorrect unless the longitude of the target is adjusted for UT1-UTC. Seaman wondered if large time differences could ever induce non-linear feedback issues like gimbal lock or problems with servo loops in tracking systems. Storz said that the first task will be to review and revise system-wide requirements to now require DUT1 where it has never been required before, and that unbounded growth of DUT1 must not cause adverse system behaviors. Terrett said that Earth-resource satellites must account for UT1-UTC for imaging resolutions better than one kilometer, but lower-resolution imaging with older spacecraft haven't had to worry about it. He clarified that space-borne software and some older systems simply cannot be updated.