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APPLYING IMPROVEMENTS IN ASTROMETRY TO SPACE SITUATIONAL AWARENESS

Abstract

Relative astrometrical VLBI (ΔVLBI) has offered about 1mas astrometric accuracy for spacecraft navigation for many years. But this is far from the current best accuracies achieved in astronomy; at 22GHz relative astrometric precision can be 10μuas for global baselines. However, this approach can not be applied to space-craft tracking as the frequencies are above those commonly used. We have been developing the next-generation of calibration techniques for astronomical applications, which are equally suitable for spacecraft navigation. Our developments offer an improvement of about three orders of magnitude over past deltaVLBI precision, at a much greater range of frequencies; potentially from 0.1 to 100GHz. At X-band we have predicted that the systematic noise floor will limit astrometry to 1μuas (5e-12 rad), which converts to 0.5m at the distance to Mars (taken here as 1E11m). It should be noted that these accuracies are for the relative separation of the spacecraft from the reference sources, which means the most suitable application will be the rapid update of the position after Trajectory Correction Maneuvers. Errors in the interpretation of such events led to, for example, the failure of the Mars Climate Orbiter. Additionally, for Low Earth Orbit satellites, we should be able to measure the actual distance to the satellite to a centimetre, through the measurement in the change of the three dimensional near-field wavefront. This work is in collaboration with the builders of the next-generation of radio telescopes, specifically under a Community Study program for the ngVLA.