

High-Precision, Early Mission, Narrow-angle Science with the Space Interferometry Mission

Stuart Shaklan, Xiaopei Pan and Mark Milman
Jet Propulsion Laboratory

We have developed a new technique, Gridless Narrow Angle Astrometry (GNAA), that allows SIM to measure relative positions with an accuracy of 1 micro-arcsecond in the first stages of the mission. Unlike the standard narrow-angle approach, GNAA does not rely on the global reference frame of grid stars that requires 5 years of observation to reach full accuracy. The technique works on short period signals (P =days to months), allowing it to be applied to many of the known extra-solar planets, a short-period black-hole binary, and intriguing radio/X-ray binaries. The science capability – 1 micro-arcsecond astrometric precision, is unique to SIM. Using GNAA, this precision can be realized early in the mission or at any time when rapid follow-up is required.

GNAA is simply the application of traditional single-telescope narrow angle techniques to SIM's narrow angle optical path delay measurements. The technique allows one to perform micro-arcsecond astrometry without solving for baseline length, precise baseline orientation, or the metrology constant term. In GNAA, a set of reference stars and a target star are observed at several baseline orientations. A linearized model is used to solve for reference star positions and baseline orientations. The target star position is determined using the estimated baseline orientations. Then the process is repeated at a later time and a conformal transformation is applied to relate the reference target stars to a common reference frame.