Wide-field Imaging Interferometry: Enabling General Astrophysics Observations with TPF-I/Darwin

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To make "general astrophysics" observations with TPF-I/Darwin, the community will desire at least moderate spectral resolution and a field of view (FOV) much larger than the "primary beam" diameter $1.2\lambda/d$ (about 0.6 arcsec for $\lambda = 10\mu$m and $d = 4$ m), where λ is the wavelength and d is the light collector aperture diameter. We have demonstrated the viability of a technique that enables wide-field imaging interferometry and spectroscopy. The method is a natural extension to "double Fourier" interferometry, which combines a Michelson stellar interferometer with a Michelson (pupil plane) beam combiner and a scanning optical delay line. Instead of scanning an optical delay range $R\lambda$, where R is the desired spectral resolution, a modestly longer delay range is scanned to accommodate the geometric delay introduced at field angles up to tens of arcseconds, and a multi-pixel detector is used to record information from many contiguous primary beams, in effect mosaicing a wide FOV. We are using the Wide-field Imaging Interferometry Testbed (WIIT) to gain experience with the practical issues associated with future space applications of this wide-field imaging technique, and we are developing new spatial-spectral image synthesis algorithms. The potential benefits of the technique to TPF-I/Darwin will be described, and data from WIIT will be used to explain the method. This research is supported by the NASA ROSS/APRA program.