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Memorie della

High resolution speckle imaging

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Abstract. The original IDL speckle imaging procedure XRESTOR is presented with sample results which show the good performance of the method.

Key words. techniques: image processing – techniques: interferometric

High spatial resolution observations are an important tool in optical astronomy. Candidate targets are solar systems objects, extra-solar planetary systems, multiple stellar systems, stars with envelopes and/or disks, and compact galactic and extra-galactic objects. Adaptive optics and speckles post-processing techniques (Roggemann & Welsh 1996) have been developed to overcome the limits set to ground-based observations by the atmospheric turbulence. The post-processing algorithms available include phase conjugation via a wavefront sensor, shift-and-add analysis, auto-correlation (Labeyrie 1979), cross-spectrum (Karbelkar 1999) and bi-spectrum (Hoffman & Weigelt 1993), or blind de-convolution (Jeffries & Christou 1993). The field of view is limited to the isoplanatic angle (Vernin et al. 1991). Astronomical references or models of the speckle energy spectrum (Korff 1971; Von der Luhe 1984)) are generally required to calibrate the atmospheric turbulence transfer function. Image restoration by speckle auto-correlation for the modulus and by speckle bi-spectrum for the phase proved to be an effective post-processing approach. Following these guidelines a portable IDL software package (XRESTOR) has been developed for the diffraction limited restoration of FITS data cubes of astronomical specklegrams. XRESTOR includes shift-and-add, auto-correlation, cross-spectrum, and bi-spectrum image restoration with reference or model calibration of the atmospheric transfer function. Moreover, the images can be pre and/or post-oversampled and post-deconvolved by means of Richardson-Lucy algorithm to further increase the spatial resolution within the diffraction limits of the telescope. Sample results in Fig. 1 show the good performance of XRESTOR.

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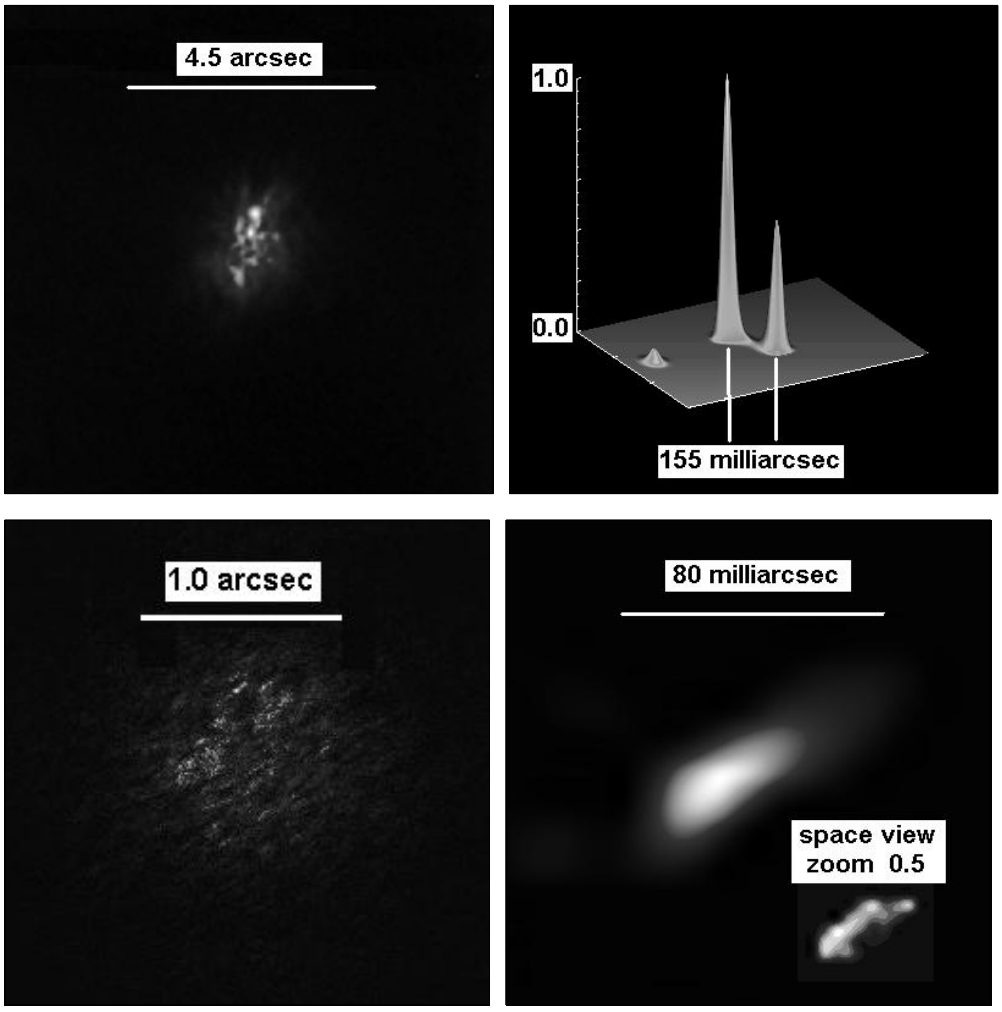

Fig. 1. One speckle of the binary star V380 with 155 milliarcsec separation observed in K-band on the Calar Alto 3.5-m telescope and the restoration (upper panels). One speckle of an Ida-like asteroid of 100 km at 1.77 AU distance (80 milliarcsec size) simulated in V-band on a 6-m telescope and the restoration (lower panels).

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