Contributed Talk

Splinter HiRes

High-resolution Fast Imager (HiFI) Image Quality and Image Restoration

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The High-resolution Fast Imager (HiFI) is one of the facility instruments of the GREGOR telescope at Observatorio del Teide, Izaña, Tenerife, Spain. High-cadence (about 50 Hz), large-format (2560 × 2160 pixels) detectors facilitate exploring the dynamic Sun with a spatial resolution close to the telescope's diffraction limit. Standard interference filters cover three interesting regions in the blue part of the spectrum, i.e., the strong chromospheric absorption line Ca II H (λ396.80 nm), the Fraunhofer G-band (λ430.70 nm), and the blue continuum (λ450.55 nm). A programmable timing unit precisely synchronizes the two scientific CMOS imagers and serves as the interface between control computer and cameras. We present preliminary HiFI results and demonstrate its science capabilities. High-cadence imaging and frame selection ('lucky imaging') in combination with real-time correction by an adaptive optics (AO) system are essential for image restoration to obtain nearly diffraction-limited solar images. Thus, assessing image quality in time-series data is very important. The 'Median Filter Gradient Similarity' (MFGS) image quality metrics is applied to AO-corrected image sequences of a pore and a small sunspot. Modifications of the MFGS algorithm uncover field- and structure-dependence of this image quality metrics. We demonstrate that fast cadence and millisecond exposure times are still insufficient to reach the coherence time of daytime seeing. This poses challenges for large-format and high-cadence detectors, which are proposed for the next generation of 4-meter aperture solar telescopes.