The low-order wavefront control system for the PICTURE-C mission: High-speed image acquisition and processing

Kuravi Hewawasam, Christopher B. Mendillo, Glenn A. Howe, Jason Martel, Susanna C. Finn, Timothy A. Cook, and Supriya Chakrabarti
Lowell Center For Space Science and Technology, University of Massachusetts Lowell, 600 Suffolk Street Suite 315, Lowell, MA 01854, USA

PICTURE-C Experiment
The Planetary Imaging Concept Testbed Using a Recoverable Experiment - Coronagraph (PICTURE-C) mission will directly image debris disks and exozodiacal dust around nearby stars from a high-altitude balloon using a vector vortex coronagraph operating at an inner working angle of 1.7 λ/D in visible light (540 nm - 660 nm).

LOWFS Event Sequence
Simplified timing diagram of the LOWFS events. These events occur in different devices of the LOWFS.

Sensor Architecture
The CCD KAI-0340 on the LOWFS camera (Bobcat B0620M) consists of an active pixels region, a buffer region and a light shielded region.

Frame Transfer Time with ROI
The frame transfer time and Δt1 of the B0620M camera can be changed by altering the size and the position of the ROI on the sensor. The center scan mode decreases the frame transfer time by a factor of 3.

LOWFS Requirement
Calculated empirically
• Rate - 200 Hz
• Total latency - 1 ms

PICTURE-C Control System
Schematic of the PICTURE-C instrument (convex shapes denote powered optics*).

MKL vs. OpenBLAS
Calculation times for different frame sizes for MKL and OpenBLAS.

Final System Total Latency
Final system configuration is as follows,
• 2-tap
• Center scan mode at 40 MHz px. clock
• ROI at bottom left corner
• 64-bit Linux mainline kernel (version 3.2.21)
• MKL 2017 update 3

IWC Controller Latency
The distribution of latency measurements for ~2000 IWC commands.

References

Send correspondence to kuravi_hewawasam@student.uml.edu

Fig. 2: IWC commands.