Laser Guide Star Wavefront Sensor Mini-Review

12/07/2009

LGS WFS Requirements Overview

- Introduction
- Requirements drivers
  - Possible drivers not fully explored

NGAO LGS WFS

- Major subsystem substantially revised by the Build-to-Cost (B2C) design decisions documented in KAON 642
  - LGS WFS outside of NGAO cold box so operation now at Nasmyth lab temperature
  - LGS asterism changed to yield better on-axis tomography and excellent sky coverage
- Post-B2C cost estimate was $2.46M
  - Estimated about $0.56M less than SDR
  - Cost to be re-visited for PD Cost Book (c. March 2010)
    - Effort has been strong push toward simplification
    - Recall O(50) mechanisms in LGS WFS SDR design

LGS WFS Requirements

- Recently re-written
  - In light of the requirements flow-down exercise and in preparation for this review
- 53 requirements available at 091207 mtg Twiki
  - Coverage of all disciplines (optical, electrical, etc.) not particularly uniform
- Parallel effort to update Contour organization (SysE group) will likely result in better understanding of missing LGS WFS requirements

Requirements Drivers I

- Asterism size and shape
  - Tight 10 arcsec (7.27 mm) radius Fixed LGS asterism drives packaging geometry
- Patrolling LGS WFS
  - Point and Shoot concept for LO WFS NGS sharpening leads to LGS WFS OSM
  - Decision to reuse LO WFS OSM design drives LGS WFS optomechanics
- “63” and “31” subapertures across the pupil
  - Set by 64 and 32 actuator MEMS DM’s
  - Actual illumination by the pupil is expected to be less than this (there remains some impreciseness in our definitions)
    - Note: the WFE budget v 2.0 will need to reflect the degrees of freedom in the illuminate pupil
- LGS stabilization on ‘downlink’
  - Integration of a fast tip-tilt mirror into each WFS drives packaging

Requirements Drivers II

- Wavefront error budget contribution from optics
  - 0.25 arcsec FWHM from all NGAO optics leading to the LGS WFS focal plane
  - Absence of flow-down allocation of this quantity has been cause of some interface confusion
- LGS WFS linearity and dynamic range
  - Drives choice of 4 x 4 pixels / subaperture
    - Choice of PSF-to-pixel ratio ‘p’ drives back-end optics
    - Final decision on ‘p’ ratios requires iteration with calibration stimulus, RTC, and MSCS teams
  - Related system issues
    - Small throw dither for centroid gain measurement
    - Quasi-GoTo control needs to be thought through more carefully
      - LGS WFS sees correction due to LODM, which is anisoplanatic for 6 of the 7 LGS WFS.
      - Will LO DM control be ‘optimal’ for science direction (alone), for the science FoV, or for a larger FoV?

Possible Requirements Drivers

- Impact of these items are not fully decided
  - Various non-atmospheric defocus terms
    - The need for individual focus mechanisms on each Patrolling LGS WFS channel is TBD (to be discussed later)
  - Operating wavelength 589 - 594 nm
    - In order to allow cost-effective testing with commercial laser source(s) to be located in the calibration stimulus
  - Fratricide
    - Impact of geometry of ‘secondary shadow’
  - OSM reliability requirements
  - Support structure and stability w.r.t. HO DM
  - Size constraints
    - None leveled on LGS WFS to date