NGAO high-contrast performance budget IPT meeting #2

12 December 2006

Present: Rich Dekany (RD), Ralf Flicker (RF), Mike Liu (ML), Bruce Macintosh (BM)
Unable to attend: Chris Neyman (CN), Claire max (CM)

Administrative: In an effort to equalize some of the work load, RF agreed to chair future high-contrast working group telecons and plan/monitor the progress of the studies.

> RD: Rich invited Ralf to chair future deliberations of this working group. Ralf accepted with support from Bruce, to ensure the significant progress in GPI infuses the NGAO high-contrast team.

Summary of current status

The group has identified two complementing classes of analyses that we plan to carry out, which cover different performance estimation fidelities and time frames:

1. Contrast estimation from modified GPI spread sheet tool (BM to provide)
2. Numerical AO simulations coupled to various coronograph models (CN, RF)

The study will focus on the first method initially, with some input to the tool to be produced by stand-alone AO simulations addressing issues concerning static/dynamic telescope errors, and to some degree of approximation LGS specific errors (e.g. spot elongation static aberrations, tomography errors, focus drifts etc). The primary goal of this first iteration is to refine and fill in numbers in the error budget and identify what the tall poles are. Some preliminary results from this study should be ready for the 2007-01-22 meeting.

The second round of contrast estimation will employ the LAOS numerical AO simulation tool for generating residual phase maps that include second-order effects which are hard to parametrize for the spread sheet tool. The output of the AO simulation is coupled to various coronograph models (to be written), and the outcome is to serve as a guide for deciding how sophisticated a coronograph we will need, and a second iteration on specific terms of the error budget.

Between now and the end of SD phase, this study should have investigated the performance of a number of specific coronograph models, including: none, ideal, standard Lyot, and apodized Lyot.

HC performance budget IPT meeting #2, notes

(RF note: what does IPT stand for?)

Action items from previous meeting

RD: discussed funding of LLNL affiliates with EC.
BM: will talk to Don about details of funding of LLNL

ML: reviewed SRD release 1 (talked to CM to make sure HC properly represented?)
RD: talked to Jamie Lloyd re: PHARO non-redundant mask calibration issues – maybe not relevant to current NGAO coronography study?

Simulations

CN & BM met on Dec 8-10 and discussed simulation details.

RD: Simulations are needed, but most can be deferred – (add to Science Products WBS?) Some exceptions to this may have arisen in Bruce and Chris' conversations of Dec 8-10 (confer with Chris for details.)

RD: Products is an assessment of how sophisticated a coronagraph is needed – we want to determine at least one coronagraph that allows the science goals to be met.

RD/BM: Bruce and Chris discussed two sets of simulations: Goal is to measure how different coronagraphs work on hexagonal tiled telescopes Earlier task would be filling in boxes in the wavefront error budget – how many actuators are needed to correct the static errors telescope errors.

Determining spatial PSD of wavefront error

RD: Ralf wrote up one approach at determining the residual power spectrum from residual tomography error. It was actually structure function that was considered. There is a 3-4 page write-up on TWiki; the basic result is that the spectrum is not strictly white, but close to it.

RF: I looked at a method for extracting the PSD from simulated AO PSFs (i.e. can be applied on LAOS generated PSFs). Report on the twiki is a first draft, will be revised within the next few days.

Telescope static & dynamic errors

RD: Ralf and Chris are looking at the residual telescope dynamical errors. It's not entirely sure right now how to incorporate the output of Monte Carlo simulations into Bruce's parametric performance spreadsheet.

RF: will look at attaching a spatial PSD estimator at the backend of the simulation to facilitate integration of the LAOS results into the GPI spread sheet tool. Need some input from Bruce to understand the formats. *[These effects are probably important, and we will give them some priority in producing the results.]*

Contrast versus radius

RD: We asked Mike whether the science was particularly interested in the details of the 'contrast vs. radius' curve; or is it sufficient to design for contrast at 0.5", with the

assumption that it will vary (relatively) slowly (within a factor of 10x) all the way from a few diffraction widths out to the outer working angle.

ML: OK (for now) to report average 0.5" contrast in a single number.

BM: can maybe parametrize the scaling law for the contrast within the inner working radius except for close to the edge.

Non-common path errors

RD: We touched upon non-common-path errors and quality of the optical system. We can't predict the level to which we'll be able to calibrate away both common-path and non-common-path errors. We are also unsure of the quality to which the LBWFS will be able to calibrate away errors due to laser guide star errors (ala Richard Clare's recent work on estimating how changes in LGS spot size within a HOWFS can change the output wavefront.) We agree that all we can do at this stage is make some reasonable assumptions (e.g. white spectrum)

BM/RD: we don't know if miscalibration from ncp errors or uncorrected telescope errors are going to be the dominating term, nor what the shape (PSD?) of these errors might look like. Need to understand.

Science requirements

RD: How do we determine the science requirements?

ML: there will be some science benchmarks to guide the requirements for contrast in at very small inner working angle.

RD: Bruce will respond to Ralf and Chris regarding what format he would like to see the output from the Static and Dynamical Telescope Wavefront Error trade studies.

LBWFS

BM/RD: what can we expect from the LBWFS (some capacity to model this in the spread sheet already?)

Action items:

CN – From previous meeting: report on talks with RC & MvD regarding data-mining Keck NGWFC for input to NGAO HC.
CN – From previous meeting: report on talks with Lisa Poyneer / BM regarding LGS specific wave-front errors that are not included in the GPI study.

BM – Send feedback to CN/RF on how to best report the outcome of current simulations of static/dynamic telescope errors in order to include the effects in the spread sheet tool
BM – Distribute version 0.1 of GPI spread sheet tool modified for NGAO by mid-January 2007, to allow feedback before Team Meeting #4 on January 22, 2007

RF – Collate and post minutes of this meeting.
RF – Write work scope planning sheet
RF – Schedule the next NGAO High-contrast IPT telecon for early 2007