Evolution of VLTI Operations – Improving the scheduling of monitoring and imaging programmes

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VLTI Operations – Types of Programmes

Our VLTI operations scheme was created based on the needs of the 1st generation instruments MIDI (2 beams) and AMBER (3 beams).

The transition from these instruments to the 2nd generation 4-beam instruments GRAVITY and MATISSE requires an evolution of the operations scheme. Some earlier requirements such as the definition of certain uv points is now much less important.

Current types of programs:

- Snapshot – 4 beam instruments with 6 simultaneous baselines
- Imaging – Combination of quadruplets
- Snapshot Monitoring – Recurrent epochs of one baseline configuration
- Imaging Monitoring – Recurrent epochs of several baseline configurations
- Astrometry – Different best baseline configurations compared to imaging?

We aim at enabling all of these types of programs in our VLTI operations scheme!

Evolution of VLTI operations underway

- The evolution of the general phase 2 scheme (e.g. web-based p2pp, API) allowed us to request as well changes that are driven by the needs of VLTI operations.
- As a result, some improvements have already been established and will be available within about the next 1 to 2 years. These concern mostly observation preparation and short-term scheduling decisions and observational efficiency. Feedback is welcome and can still be incorporated.
- Other improvements are being discussed. These concern rather the long-term scheduling of the baseline configurations. Feedback is encouraged.

VLTI Operations – Baseline configurations

- UTs: UT1/UT2/UT3/UT4 – 47-130m

- AT Small: – A0/B2/C1/D0 – 10-40m
- AT Medium: – D0/G2/J3/K0 – 40-100m
- AT Large: – A0/G1/J2/J3 – 60-140m
- AT Large astrometric (all south): A0/G1/J2/K0 (GRAVITY DF)

Reconfiguration of AT quadruplets takes 1-2 days. Intermediate configurations exist and are currently not used.

VLTI Operations – Constraint I - Baselines

VLTI OBs have the baseline as additional constraint, making operations less flexible compared to VLT instruments, and complicating the schedule

- Increase of SM fraction encouraged; Still problematic situation for UTs.
- Proposed change to configurations called small/medium/large with some more flexibility and guaranteeing only the ranges of baseline lengths. Enables the use of intermediate baselines and of more configurations of a kind to improve the uv-coverage for imaging for instance. Changes in the tools such as OT scheduled for 2018.
- Upcoming support of alternate baselines in p2pp. Note the large overlap in particular between the medium and large configurations. Changes in the tools (p2pp and OT) scheduled for 2018.

VLTI Operations – Constraints II - Observability

Observability is also constrained by delay line restrictions and shadowing of ATs by UTs. LST constraint in p2pp is currently used to encode the observability.

- Effort last year to make this consistent between all different tools
- Observability calculations will be moved from observation preparation (p2pp/ EVM) to execution (OT), scheduled for 2018.
- This is also a pre-requisite to move to configurations small/medium/large guaranteeing only the baseline ranges rather than the exact configuration.

VLTI Operations – Constraints III – Sequences

- Sequences of Science/Calibrator (C-S, C-S-C, C-S-C-S-C)
  - Concatenations are mandatory, no possibility for time-linked containers
  - There is a workaround using absolute time intervals taking into account the schedule, but which is not ideal

  - "Nested" containers will allow the combination of concatenations and time-link containers, scheduled for 2018
  - We do notice that several service−mode PIs (especially GRAVITY) request more flexibility in defining the sequences. We plan to allow more flexible sequences within a given execution time (of standard 1h or even 2h after approved waiver) as of Phase 2 of P100. ETC needs to be improved to make full use of this flexibility.

VLTI Operations – Constraints III – Aperture Synthesis

Aperture synthesis imaging requires the filling of the uv plane by combining different baseline configurations and making use if Earth rotation. So far, this has been encoded in the baseline constraint and the LST range.

- Improved Support in OT for Imaging programmes, scheduled for 2019:
  - Visualization of all uv points that have been obtained so far for a given programme + target, plus the position of a uv point that would be added with a certain configuration at a certain time
  - Algorithm that determines for which programme + target within the queue we would get the most significant improvement of the uv coverage
- Algorithm:
  - Definition not yet clear
  - Which is the best uv filling for imaging? Uniform? Certain patches?

Long-term scheduling – Very preliminary Ideas / Discussion

- Partly pre-defined baseline schedule ("block scheduling" as for ALMA) before CfP, adjustments at scheduling phase, as well as during the period
- Monitoring:
  - Cycling between the (three) offered configurations at pre-defined intervals of 1 or 2 weeks - Which frequencies of monitoring within a period are needed? Days/Weeks/ Months?
- Imaging
  - Making use of intermediate configurations during re-configuration nights?
  - Have more configurations of a kind (i.e. small/medium/large) to improve the uv coverage?
  - Dedicated imaging slots of 1-2 weeks in service mode once or twice per semester, combining a few imaging programmes. Moving from configuration to configuration as we progress. Requires reactivity of PIs and possibly of QC Garching?

Discussion

Note that the ideas on long-term scheduling (partly pre-defined schedule) are at an early stage. They have political and technical implications that need to be evaluated. To proceed with this:

- Is it fine for you if we guarantee only the interval of baseline length but not certain configurations?
- Is it fine for you to give up in parts a completely science-driven baseline schedule for a partly-pre-defined schedule ("block-scheduling" as for ALMA), for the sake of an overall higher efficiency?
- Which is the best filling of the uv coverage for imaging? Is there an algorithm for it?
- Which monitoring frequencies are (most) required?
- Other ideas?