Preparing for the ESO Public Surveys with VISTA and VST: New Tools for Phase 2 and a Workshop with the Survey PIs

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New Phase 2 tools are described to support service mode operations for large public surveys. A workshop was held with the principal investigators and selected team members of the VISTA and VST surveys to introduce the new tools.

Outline

Observational astronomy is in an era of surveys, with the Sloan Digital Sky Survey (SDSS), UKIRT Infrared Deep Sky Survey (UKIDSS), Panoramic Survey Telescope & Rapid Response System (Pan-STARRS), SkyMapper and the Large Synoptic Survey Telescope (LSST) to name only a few of the major projects. All of these are large investments in survey *systems*, ranging from dedicated telescopes and instruments to data distribution. The goal common to all these projects is to target new science in a vast variety of fields and serving broad communities. The VISTA and VST public surveys are ESO's response to these new demands.

In the scheme of ESO service mode operations, the public surveys represent a challenge because they require the definition of several thousands of observing blocks that need to be managed, scheduled and executed in the most efficient way. In this article we present the new Phase 2 tools being developed to support the service mode operations for public surveys, and report on the ESO workshop with the survey principal investigators (PIs) as an example of ESO's commitment to the support of the first survey Phase 2.

Challenge of Phase 2 for public surveys

The ESO public surveys on the near-infrared 4 m telescope VISTA (Emerson et al., 2006) and the optical 2.6 m telescope VST (Capaccioli et al., 2005) are ambitious projects that range from those with very wide area coverage with short exposures, like the Vista Hemisphere Survey (VHS) survey that aims to cover the whole southern hemisphere, to deep surveys concentrating on small areas, but going very deep. Typical examples of the latter are the UltraVISTA and the VISTA Deep Extragalactic Observations (VIDEO) survey; for an overview of the six VISTA and the three VST public surveys see Arnaboldi et al. (2007). Both wide and deep surveys are similar in terms of the total amount of observing time, although their observing requirements, e.g., seeing, sky transparency, moon illumination and RA range, may be complementary. The size of survey projects has a strong influence on their operations.

The unit observation at ESO telescopes is called the Observing Block (OB), and the total execution time of an OB is limited to one hour. The current number of OBs prepared, submitted and scheduled in service mode annually for all the VLT instruments on the 4 Unit Telescopes (UTs), including carry-over and large programmes, is shown in Figure 1.

In VLT service mode operations we currently schedule 3 000–5 000 OBs per year per telescope on average. Based on the Public Survey Management Plans submitted by the survey PIs, the expected number of OBs estimated by the ESO Survey Team (EST) is three to five times larger. Furthermore, since there are only six programmes on the VISTA telescope, then for Phase 2 each survey team must prepare more than 1000 OBs per semester. Clearly the current manual editing of parameters in each OB is not up to this task, and therefore ESO and the VISTA consortium have developed new tools to support the survey Phase 2.

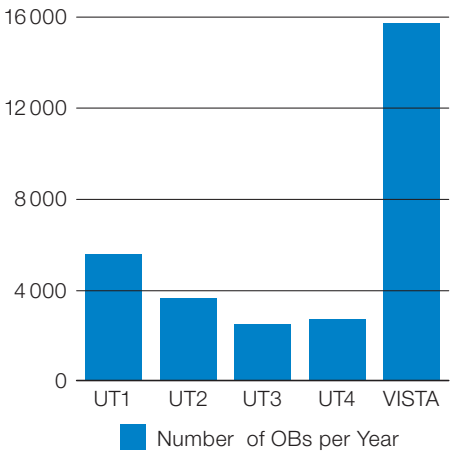

Figure 1. Average number of OBs scheduled in service mode per year over the last two years (including carry-overs and large programmes) on the 4 UTs and the comparison with the estimated average number of VISTA OBs in one year. The histogram does not include the VST OBs.

Phase 2 tools

The generation of thousands of OBs can be simplified when we separate the geometry of the surveys, i.e., where to point on the sky, from the observation strategy, e.g., how many filters, epochs and their order of execution. Both ESO and the VISTA consortium have been developing the necessary new capabilities within the ESO P2PP (Phase 2 Proposal Preparation tool) and the SADT (Survey Area Definition Tool) specifically for the preparation and support of the ESO public surveys. These survey preparation tools are currently being optimised for VISTA operations, expected to start in early 2009. Subsequently they will be upgraded to support VST operations.

In preparing observations for public surveys, users will have to define the geometry of the survey areas using SADT. The output from SADT will then be imported into the new P2PP for surveys, version 3.1, to prepare valid OBs.

SADT: The Survey Area Definition Tool is a utility developed by the VISTA Consortium that allows users to define areas to be covered by surveys executed with either VIRCAM at VISTA or OmegaCam at the VST according to a number of criteria. SADT determines the central coordinates of the different pointings required

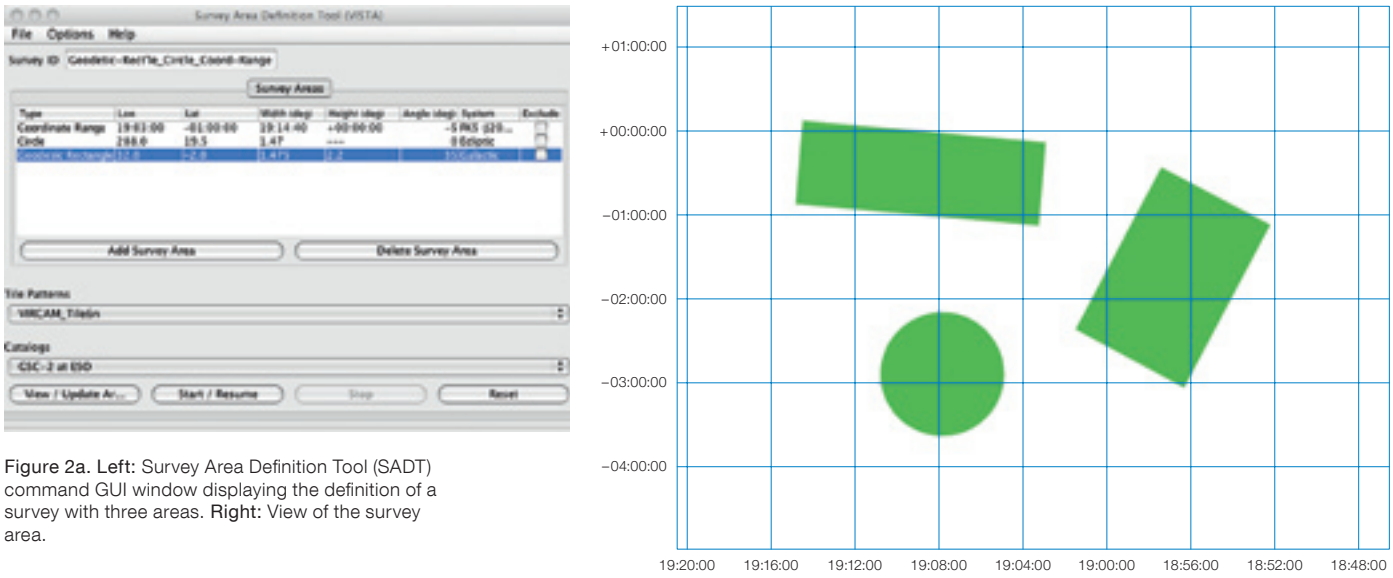

Figure 2a. **Left:** Survey Area Definition Tool (SADT) command GUI window displaying the definition of a survey with three areas. **Right:** View of the survey area.

to cover the field according to the specifications, as well as ancillary guide star information to allow acquisition and guiding. The output of SADT is a file to be ingested by P2PP that contains all the target information needed for the preparation of the OBs with which the survey will be executed.

The IR detectors in the VISTA focal plane are not contiguous, so a single sky exposure has large gaps between the areas covered by the detectors, also known as "pawprints". To make an image without gaps several (minimum six) pawprints with position offsets must be combined so as to cover the gaps and form a filled "tile". In order to survey a given area, the positions of the tiles that VISTA should observe must be defined and for each pawprint in each tile suitable candidate guide stars and active optics (aO) stars must be pre-selected, ready for use when the observation is made. This procedure ensures that the survey speed is not limited by frequent operator intervention.

In Figures 2a and 2b, we show the SADT command GUI and reproduce an image of the plot window, showing the three areas defined for a given survey. Figure 2b shows the pawprints and the tiles defined for this survey.

P2PP: The Phase 2 Proposal Preparation tool has been in use with ESO telescopes since 1997 and has evolved since then to adapt to both operational and user-friendliness needs, as they have been identified, and to provide enhanced functionality. P2PP development continues, and it is currently focused on specific requirements set by the ESO public survey programmes with the survey telescopes, VST and VISTA on Paranal. However, most of these new functionalities and enhancements to P2PP will be of use for all service mode users of ESO telescopes, including those conducting normal programmes. The use of the new P2PP for surveys will be extended to normal programmes on the VLT and other telescopes in the future.

To prepare observation blocks for VISTA and VST surveys, the survey definition generated by SADT is given as input to P2PP. Then P2PP combines the survey definition with 'parent' OBs, i.e., OBs where exposure times, filters, dithering patterns and observing constraints are set, but which lack pointing information. The parent OBs can be a single OB, or mulitple OBs, which are then structured

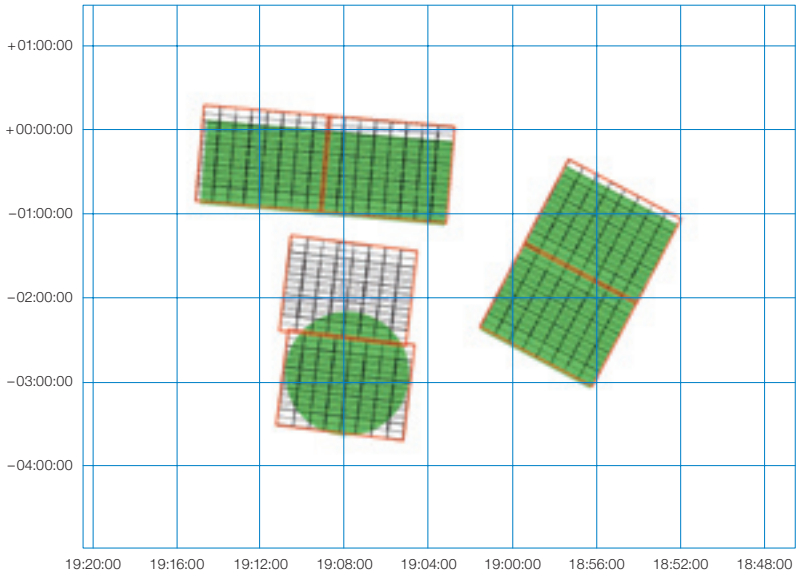

Figure 2b. Pawprints (black contours) and tiles (red squares) computed for the survey area defined in Figure 2a.

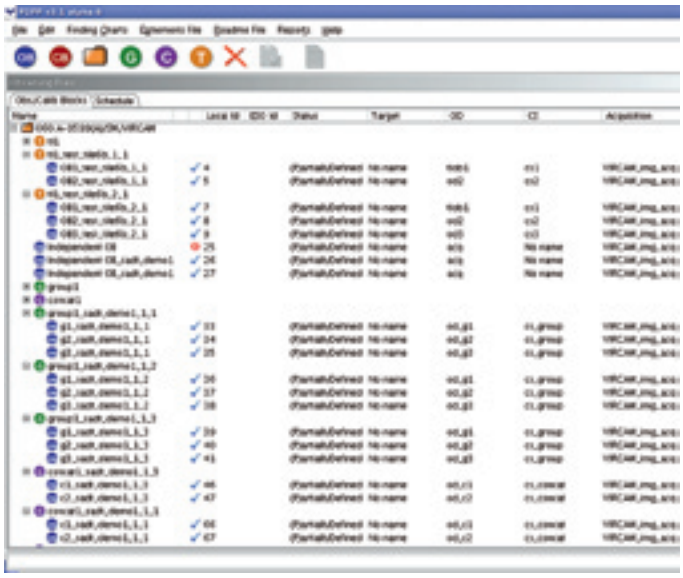

Figure 3. The main P2PP GUI showing the view for Obs/Calib blocks.

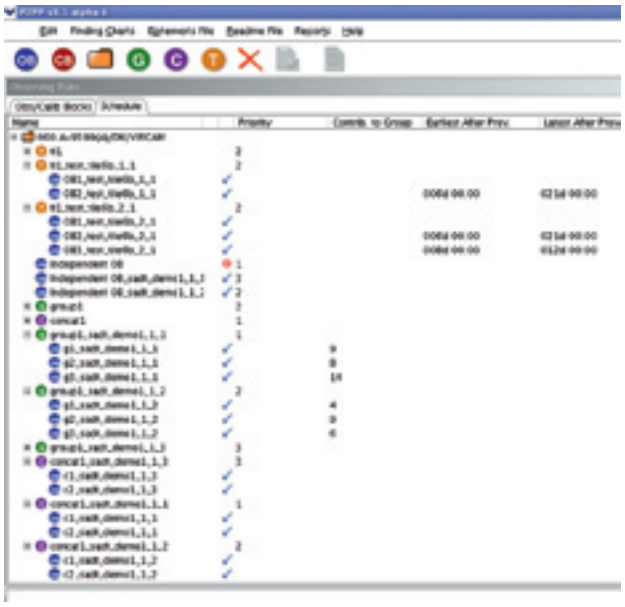

Figure 4. The main P2PP GUI showing the Schedule view.

into an observing strategy. The observing strategy may require grouping OBs with different priorities, chains of OBs, or a time sequence of OBs. The new version of P2PP allows the implementation of these different observing strategies via the scheduling containers defined as time-links, concatenations and groups of OBs. In Figure 3 we show the P2PP main GUI and describe the scheduling containers.

– *Time-linking of OBs:* It may be a requirement that certain OBs must be executed within precise time windows, rather than any time when the external conditions (phase of the Moon, seeing, transparency, etc.) would allow their execution. The following types of time-dependencies can be recognised: absolute time constraints, e.g., an OB must be executed at specific dates that can be predetermined (an example is the observation of a binary star at a precise phase of its period), or relative time links, implying that an OB must be executed within a time interval after the execution of a previous OB, but not necessarily at a fixed date. Examples of this latter are monitoring observations of a variable source at roughly constant intervals.

– *Concatenation of OBs:* In some cases the OBs should be executed consecutively, with no other observations in between. This has been implemented in the P2PP for surveys within the new 'concatenation' container. The concatenation container consists of two or more OBs that must be executed back-to-back without breaks, regardless of the order of execution. In a concatenation, once an OB fails, the whole concatenation must be repeated.

– *Definition of groups of OBs:* At present it is possible to assign an execution priority to each OB, so that the operator is aware of those with a higher scientific importance, when the time comes to decide which observations to execute for a given programme. It has, nevertheless, been recognised that such a simple priority scheme is sometimes insufficient to define the observing strategy of a more complex programme. This is especially true for surveys containing large numbers of target fields observed in a number of instrumental setups. In such cases the need for a prioritisation scheme, at a level above the individual OB, which can take into account the past execution history of the programme, becomes clear. One can consider, for instance, the case of a survey of several target fields to be observed through several different filters, with each field and filter specified in a single OB. Depending on the science goals of the programme it may be desirable to complete the observations of a given field in all filters before proceeding to the next field or, conversely, to observe all fields in a given filter before proceeding to the next filter. The group scheduling container allows any such strategies to be implemented.

In Figure 4 we show the P2PP GUI where the user can set group priorities and time-link constraints. Once the parent OBs are defined in P2PP, the user can import the target fields produced by SADT and then the parent OBs are replicated and combined with each tile (or pawprint) defined in the survey area. The result will be a large series of OBs stored in the ESO OB repository and made available for execution.

Workshop with the survey PIs

The Phase 2 tools for public surveys were presented to the survey teams during a two and a half day workshop held at

ESO, Garching on 15–17 September, 2008. The PIs of the ESO public surveys were invited to attend the workshop, together with two additional team members who would then be in charge of the preparation of the Phase 2 submission. More than 30 astronomers from both VST and VISTA survey teams attended the Phase 2 workshop.

During the workshop, each team was trained with the new survey Phase 2 tools installed on ESO computers, and invited to prepare OBs for the Phase 2 submission, equivalent to the first year of survey observations. Given the overlap in scientific goals and the connection between the VISTA and the VST public surveys, the three VST PIs were also invited to join the corresponding VISTA teams for the Phase 2 preparation exercise.

The Survey Phase 2 workshop included a presentation of the VST and VISTA status, an overview of the survey telescope operations and the presentation of the Phase 2 tools. The second day was devoted to a demonstration of the Phase 2 tools, SADT and P2PP, followed by tutorials organised by the ESO Survey Team (EST). This interaction allowed a fruitful exchange and feedback for further optimisation of the tools. On the third day the programme for VISTA science verification was presented to the survey teams, followed by a discussion on the science goals of the surveys and the readiness of the individual survey teams for the start of these challenging projects.

References

Arnaboldi, M. et al. 2007, The Messenger, 127, 28
Capaccioli, M., Mancini, D. & Sedmak, G. 2005, The Messenger, 120, 10
Emerson, J., McPherson, A. & Sutherland, W. 2006, The Messenger, 126, 41

Announcement of the Workshop

The E-ELT Design Reference Mission and Science Plan

26–28 May 2009, ESO Garching, Germany

As part of the FP7 funded "E-ELT Preparatory Phase" programme, ESO will host a three day workshop on the E-ELT Design Reference Mission (DRM) and the Design Reference Science Plan (DRSP). The aim is to bring together members of the community, various instrument study teams, members of the E-ELT Science Working Group and the E-ELT Science Office at ESO to present and discuss the results of the DRM simulations. Details and first results of the DRSP will also be presented and discussed.

For further details and registration please refer to *http://www.eso.org/sci/facilities/eelt/science/drm/workshop09/.*

Announcement of the Workshop

Imaging at the E-ELT

29 May 2009, ESO Garching, Germany

Also as part of the FP7 funded "E-ELT Preparatory Phase" programme, ESO will host a one day workshop on the specific topic of "Imaging at the E-ELT". The aim is to bring together members of the community currently working on wide field imagers on 4–8 m-class telescopes and on topics related to imaging at the ELT. The goal is to explore synergies with and alternatives for wide field imaging at the E-ELT. This workshop will take place immediately after the workshop on the E-ELT Design Reference Mission and Science Plan (see above).

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