

## Survey Definition Tool

Martin Folger, Mark Casali, Andrew Vick

*UK Astronomy Technology Centre, Royal Observatory, Blackford Hill,  
Edinburgh EH9 3HJ, UK*

**Abstract.** A Survey Definition Tool (SDT) has been developed at the UK Astronomy Technology Centre (UK ATC) in Edinburgh. It automatically fills an area of sky with telescope positions selecting suitable guide stars in the process. The telescope positions are grouped together in tiles, i.e. user defined patterns of positions that depend on the detector layout of the instrument as well as on the observation and data reduction strategy used. The resulting list of positions is split into manageable chunks and formatted for use by the telescope's observation control system. The SDT was developed for the Infrared Deep Sky Survey (UKIDSS) at the UK Infrared Telescope (UKIRT) in Hawaii. The survey instrument, WFCAM, is currently being built at the UK ATC. The SDT is implemented in Java and can easily interface to other Java packages used in astronomy.

### 1. Background

In 2004 a survey instrument, WFCAM<sup>1</sup>, will be commissioned on UKIRT (Henry et al. 2003). This will require some changes to the way observations are set up. Currently an Observation Preparation Tool (OT) is used to set up the observation parameters such as instrument settings, filters etc. (Folger et al. 2002). In common-user mode the telescope position for an individual observation is also set manually in the OT. However, manually selecting the hundreds or thousands of telescope positions that make up a survey would be cumbersome. Instead a Survey Definition Tool (SDT) has been developed to automate this task. The output of the SDT (telescope positions and guide stars) can be combined with the output of the OT (instrument settings etc.) to form a complete definition of the survey (see Section 4.).

Apart from its use for WFCAM/UKIDSS (Warren 2002) at UKIRT the SDT can be readily modified for use with other telescopes and instruments. Its use with future instruments on the James Clerk Maxwell Telescope (JCMT), such as SCUBA-2 (Holland et al. 2003) and ACSIS (Hovey et al. 2000) is being considered.

---

<sup>1</sup><http://www.roe.ac.uk/atc/projects/wfcam>

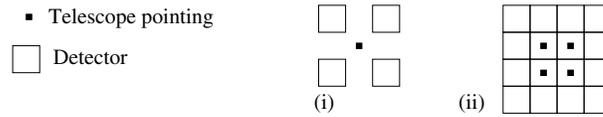


Figure 1. Tile for multi-detector instrument WFCAM.  
 (i) One telescope position with footprint (four detectors).  
 (ii) Four telescope positions forming a filled-in tile.

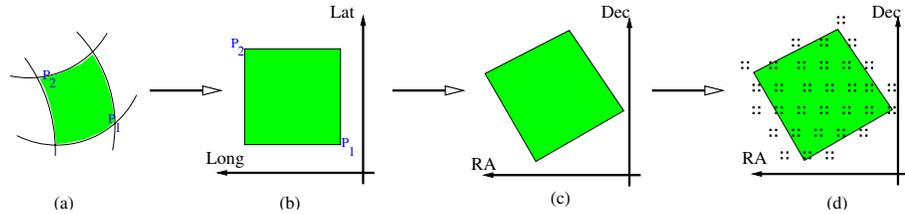


Figure 2. Tiling Algorithm: Survey Area transformed and filled with tiles/telescope pointings

## 2. Tiling Algorithm

*Tiles:* Each telescope position results in a detector footprint on the sky. For various reasons it can be necessary to group several of these footprints together to form a tile. In the case of multi-detector instruments tiles can be used to fill the gaps between the detectors (see Figure 1). Alternatively, tiles may be designed such that the detector footprints have large overlaps if this is desired for data reduction.

*Survey areas:* A survey is made up of a number of *rectangular* or *circular* survey areas. Rectangles are defined in terms of the coordinates of two of their corners. Circles are defined as a centre position and a radius. Areas that should be excluded can also be specified.

A distinction is made between the *input* and the *output coordinate system*. The former is used to specify the rectangular and circular survey areas. The latter is used for the coordinates of the telescope positions which make up the tiles that fill the survey areas. These tiles are placed along rows of constant declination or latitude in the output coordinate system.

Figure 2 shows how this approximately looks like for a small survey area defined by two points  $P_1 = (260.0, 20.0)$  and  $P_2 = (265.0, 25.0)$ , in degrees, using galactic coordinates as input coordinate system (a). Plotting this as a Cartesian coordinate system yields a rectangle (b) which is converted to the output coordinate system, in this case FK5 J2000.0 (c). This is then tiled, with each tile comprising 2 x 2 telescope positions (d).

*Automatic guide star selection:* A Java class has been developed which reads locally installed binary USNO catalogue files and is compatible with the catalogue handling in ESO's JSkyCat<sup>2</sup>. This makes it easy to switch between

<sup>2</sup><http://archive.eso.org/skycat>

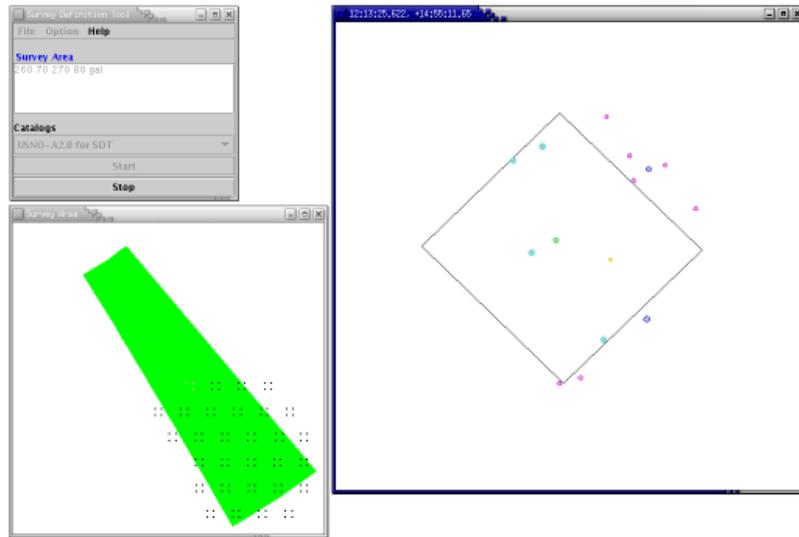


Figure 3. User Interface

the local catalogue and online catalogues. If a suitable guide star cannot be found for one or more positions in a tile then this tile is shifted back until guide stars for all its positions can be retrieved from the catalogue. The following tiles in the same row are shifted accordingly.

### 3. User Interface

The SDT is implemented in Java. It uses some classes from the UKIRT/JCMT OT and the JSky<sup>3</sup> package.

Figure 3 depicts the SDT halfway through creating the telescope positions for a survey area: main window (top left), survey area with telescope positions (bottom left) and autoguider footprint (diamond) with guide star catalogue query results.

Users can specify tile and position offsets, autoguider dimensions and guide star selection criteria in a configuration file.

### 4. Interface to Observation Control System (OCS)

One use of the SDT is as a generic standalone application that writes the defined telescope positions in a simple format to an ASCII file. The latter might then be read as data by other systems.

Additionally the SDT provides functionality for close integration with the UKIRT/JCMT OCS (Bridger et al. 2000; Rees et al. 2002). The telescope

---

<sup>3</sup><http://archive.eso.org/JSky>

positions created by the SDT can be read into a TOML<sup>4</sup> Science Program (de Witt et al. 2004, in preparation), an XML-based description of observations used by the Observation Management Project (Economou et al. 2002).

The user can create template observations using the OT. In these template observations all parameters needed to set up an observation are specified (i.e. exposure time, filter etc.), except the telescope position. The SDT will automatically break down its list of telescope positions, combine them with the template observations and group them into *Minimum Schedulable Blocks* which make up a TOML Science Program.

Optionally any of these observations can be individually loaded into the OT which can display telescope position, guide star and detector footprint in a JSkyCat window and the settings can be modified if necessary.

**Acknowledgments.** We would like to thank those members of the UK Astronomy Technology Centre, the Institute for Astronomy of the University of Edinburgh and the Joint Astronomy Centre in Hilo, Hawaii who have offered advice during the design of the Survey Definition Tool and helped testing it.

## References

- Economou, F., Jenness, T., Tilanus, R., Hirst, P., Adamson, A. J., Rippa, M., Delorey, K., Isaak, K. 2002, in ASP Conf. Ser., Vol. 281, ADASS XI, ed. D. A. Bohlender, D. Durand, & T. H. Handley (San Francisco: ASP), 488
- Folger, M., Bridger, A., Dent, B., Kelly, D., Adamson, A., Economou, F., Hirst, P., Jenness, T. 2002, in ASP Conf. Ser., Vol. 281, ADASS XI, ed. D. A. Bohlender, D. Durand, & T. H. Handley (San Francisco: ASP), 453
- Henry, D. M., Casali, M. M., Montgomery, D., Burch, K., Laidlaw, K., Ives, D. J., Vick, A. J. A., Bridger, A., Lunney, D., Adamson, A. J., Rees, N. P., Chylek T., Chuter, T. C. 2003, Proc. SPIE, 4841, 63
- Holland, W. S., Duncan, W., Kelly, B. D., Irwin, K. D., Walton, A. J., Ade, P., A. R., Robson, E. I. 2003, Proc. SPIE, 4855, 1
- Hovey, G. J., Burgess, T. A., Casorso, R. V., Dent, W. R., Dewdney, P. E., Force, B., Lightfoot, J. F., Willis, A. G., Yeung, K. K. 2000, Proc. SPIE, 4015, 114
- Rees, N. P., Economou, F., Jenness, T., Kackley, R. D., Walther, C. A., Dent, W. R. F., Folger, M., Gao, Xiaofeng; Kelly, D., Lightfoot, J. F., Pain, I., Hovey, G. J., Redman, R. O. 2002, Proc. SPIE, 4848, 283
- Warren, S. 2002, Proc. SPIE, 4836, 313
- Wright, G. S., Bridger, A. B., Economou, F., Adamson, A. J., Currie, M. J., Pickup, D. A., Tan, M., Rees, N. P., Purves, M., Kackley, R. D., Folger, M. 2001, in ASP Conf. Ser., Vol. 238, ADASS X, ed. F. R. Harnden, Jr., F. A. Primini, & H. E. Payne (San Francisco: ASP), 137

---

<sup>4</sup>Telescope Observation Mark-up Language, <http://omp.jach.hawaii.edu/schema/TOML>