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An Observer's View of the ORAC System at UKIRT

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Abstract. The Observatory Reduction and Acquisition Control system (ORAC) was commissioned with its first instrument at the UK Infrared Telescope (UKIRT) in October 1999, and with all of the other UKIRT instrumentation this year. ORAC's advance preparation Observing Tool makes it simpler to prepare and carry out observations. Its Observing Manager gives observers excellent feedback on their observing as it goes along, reducing wasted time. The ORAC pipelined Data Reduction system produces near-publication quality reduced data at the telescope. ORAC is now in use for all observing at UKIRT, including flexibly scheduled nights and service observing. This paper provides an observer's perspective of the system and its performance.

1. Introduction

The UKIRT ORAC project aimed to improve the observing efficiency and publication rate at UKIRT. It did this by making it simpler to prepare observations in advance, by giving observers feedback on their observing as it goes along, and by producing near publication quality reduced data at the telescope. In May–Aug 2000, integration and commissioning with the entire UKIRT instrument suite was completed, following the successful commissioning run with the near-IR camera UFTI in October 1999. The ORAC software has now replaced all of the software at UKIRT that interacts with observers.

ORAC is an integrated suite of software which provides a modern observing interface covering three key areas: advance preparation and specification of observing parameters (ORAC-OT); sophisticated scheduling and sequencing of the instrument and telescope (ORAC-OM); and automatic data reduction producing close to publication-quality images and spectra in real time (ORAC-DR). More detailed descriptions of the ORAC software have been presented in Bridger et al. (2000a, 2000b), and Economou et. al (1999) and references therein. This paper provides an overview of the system from a users point of view.

2. Preparing to Observe

Software which enables the astronomer to specify prior to observing precisely how their observations should be obtained reduces instrument and telescope set-up time during observing. A good remote preparation tool also allows observations to be prepared in the UK, or elsewhere, to a level such that other people know exactly what to do to obtain the data efficiently during "service" and "queue-scheduled" nights. The ORAC Observing Tool (ORAC-OT) was developed from the Gemini Observing Tool (Wampler et. al 1997), and thus inherited much of its functionality. An important feature for the observer is a visual Position Editor which is used to specify guide stars, and check positions and offsets. The Position Editor shows the area around a target which can be reached by the UKIRT guider and areas that are vignetted, as well as the science field of view.

The UKIRT use of the ORAC-OT is heavily based on a number of Library Programs which contain templates for all the common observing techniques at UKIRT, as well as fully defined standard star observations. For observers using the tool without the assistance of staff astronomers, we added intelligence to the OT components that specify instrument configurations, and have also found that a check or validation facility for observations is invaluable. For example, when specifying the configuration of the grating spectrometer CGS4, observers enter the desired grating, central wavelength for the spectrum, and an estimated source brightness, and then may use default buttons to automatically select the recommended order, on-chip exposure time, and other parameters, based on simple table-driven rules. All of these can be easily over-written if the observers choose to use their own settings instead. This level of help has made preparing to observe much easier for most people, but still allows expert users freedom to use non-standard setups. Although preparation now consists of completing a template for each source, errors are still possible. The validation facility both confirms that an observation or science program is executable (e.g., coordinates can be reached by UKIRT) and warns if it may not be scientifically complete (e.g., absence of normal calibrations). The ORAC-OT will be released for remote use at users home institutes in the near future. In the meantime it is used at the JAC to prepare before going to the summit to observe, so that UKIRT staff can gauge user reaction, and fine tune the automation of value specification. Users have found the combination of template libraries and default keys easy and efficient to use.

3. Observing with ORAC

The ORAC-OM is run at the telescope on a dedicated Solaris workstation and enables the observer to select which observation in their program is to be carried out and then to control the progress of that observation's execution by the system. The ORAC-OT is also run at the telescope so that any last minute adjustments to parameters can be made e.g., if the observing plan changes in response to newly acquired data, or the seeing changes sufficiently to require changes to the on-chip exposures. ORAC-DR is started up and it then reduces the data automatically as they appear. When the observer sends an observation

Figure 1. The ORAC-OM in use at UKIRT

for execution its "astronomer-friendly" form becomes a real executable sequence of commands. These include the instrument aperture, used to automatically adjust the telescope pointing for changes in the instrument or instrument read area, as well as the telescope slewing commands. The automated inclusion of the instrument aperture has helped to make changes between instrument configurations, and target acquisition in general, much faster.

An important part of the ORAC-OM is the user interface to the sequencer software which controls and sequences the instrument set-up and telescope positioning, and instructs the instrument when to take data. A real time display of the executable sequence of telescope and instrument actions is provided and observers can start/stop/abort observing at any point. The display also provides feedback as to sensible stopping places which ensure completed reducible data sets - in the example in Figure 1 these are after every set of four offsets, marked by a dotted line. The observer can request a stop at this "break point" rather than keeping track of data frames manually. This OM sequence console is also responsible for showing you the status of the instrument and the data acquisition.

4. On-line Data Reduction

The purpose of the ORAC Data Reduction system is to offer observers near real-time data reduction, and hence to let them easily assess the quality of their data while observing. This results in more efficient use of the telescope (stop when you have sufficient signal to noise) and better quality data (take another standard /longer exposures if need be). Rather than consisting of large packages

dedicated to each instrument, ORAC-DR uses Starlink's general-purpose data-reduction software, and drives it via a modular pipeline. The pipeline manager detects when a raw data frame becomes available, and reduces it using the recipe specified in the data header. ORAC-DR is described in more detail in Economou et al. (1999, 2001). Each observation defined with the OT contains a recipe name through which the user selects how the data should be reduced. A set of jittered frames taken with one of the UKIRT cameras could be reduced using a recipe called JITTER_SELF_FLAT, or perhaps JITTER_SELF_FLAT_APHOT if photometry of the point sources is desired. Although the reduction steps are automated, the results, including intermediate steps, are available for interactive analysis and display (slices, spectral extraction, seeing measurements, etc.).

5. Conclusions

The ORAC software suite has achieved its goal of making observing at UKIRT easier, and has been well received by observers. Efficiency gains are of course difficult to quantify, although we are in the process of acquiring relevant statistics, and impact on the publication rate could take a long time to assess. Almost all users have found ORAC to be more efficient and easier, and a variety of aspects of the system have contributed to this. For example users no longer spend time looking for suitable guide stars, switching instruments is much faster and fewer manual actions are needed overall. Initial assessments indicate that on average about a 20% gain in efficiency has been achieved.

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