KCWI N&S GUI (KNASGUI)
Functional Requirements

Revisions

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| **Date** | **Version** | **Authors** | **Description** |
| 2014-06-18 | 1.0 | Shui H. Kwok | Initial draft |

# Introduction

This document specifies the software requirements for the KCWI Nod and Shuffle Graphical User Interface, KNASGUI. The requirements are based on KCWI Design Note 0017.02 by Don Neill and Matt Matuszewski. Previous work on the prototype for N&S scripting also contributes to these requirements.

In the Note 0017.02, the top level requirements are listed as follows:

* 1. Allow observers to generate a WMKO star list that defines a ‘menu’ of science targets and background fields using online images and/or user provided images.
	2. Select guide stars and guide camera pixel positions for each item in the star list.
	3. Allow the observer to intuitively assemble an N&S script for each science target using from one to many background fields from the menu of targets listed in the star list.
	4. At the telescope, allow the user to efficiently rehearse and adjust each N&S script to ensure the quick and accurate acquisition of the guide stars during execution.
	5. At the telescope, allow the user to execute the N&S script while displaying the progress through the script and the current status of all involved instrument components.
	6. Provide a way to pause, resume, stop, and abort exposures and scripts and provide for the recovery of a known state from error and/or failure conditions.

These 6 top level requirements represent separate software modules, each with defined inputs, outputs and interfaces.

# Star List – Requirements

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| ID: | 1 | Name: | Create | Group: | SL |
| Dependencies: |  | Priority: |  |  |  |
| Description: | KNASGUI must allow user to create a new star list. When a new star is created, it is empty.A new star list is stored in a file with a new filename that user must provide.File path name must be unique; otherwise star list is not created. |

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| ID: | 2 | Name: | Load | Group: | SL |
| Dependencies: |  | Priority: |  |  |  |
| Description: | KNASGUI must allow user to load an existing star list for editing.User must provide a file path or the file is chosen via a file selection dialog window.Once file path is selected, the star list is imported and displayed. |

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| ID: | 3 | Name: | Save | Group: | SL |
| Dependencies: |  | Priority: |  |  |  |
| Description: | KNASGUI must allow user to save star list to a file under the same name or another name.A star list always has a name associated with it since a name is provided at creation time.If a new file name is used to save the star list, the new file name becomes the current name. |

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| ID: | 4 | Name: | Edit | Group: | SL |
| Dependencies: |  | Priority: |  |  |  |
| Description: | Once a star list is loaded, KNASGUI must allow user to:* view the content of the star list;
* add a new science target;
* modify coordinates and parameters for an existing target; and
* delete a science target.

KNASGUI must save changes in a regular interval no less than 5min. This prevents loss of data in case the user forgets saving or system crashes.Each science target must be specified with:* ID, 16 characters maximum
* RA in hour
* DEC in degree
* equinox, (year decimal, or apparent APP)
* an optional list of parameters
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| ID: | 5 | Name: | List View | Group: | SL |
| Dependencies: |  | Priority: |  |  |  |
| Description: | KNASGUI must provide a display showing available star lists in the current directory and provide ways to navigate to other directories. KNASGUI must allow user to* copy star lists and
* remove star lists.
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| ID: | 6 | Name: | Format | Group: | SL |
| Dependencies: |  | Priority: |  |  |  |
| Description: | KNASGUI must check the syntax of a star list before loading.Incorrectly formatted portions of the star list should be marked as comments.KNASGUI must save correctly formatted star list.  |

# Guide Star – Requirements

A star list can have any number of science targets. A science target can be associated with one or more:

* guider stars
* offset stars
* background fields, identified with a reference star in the field

Each of these associations must be given a unique ID within the star list. The rotation angle for the guider camera can be specified and is assumed to be 0 if not specified.

Option parameters:

* guidepa: rotation angle for guide camera in degree
* raOffset: offset in RA for offset stars in arcsec
* decOffset: offset in DEC for offset stars in arcsec
* type: one of guide, offset, background
* gxpos: position of reference star in X-axis of guider camera
* gypos: position of reference star in Y-axis of guider camera

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| ID: | 7 | Name: | Guide star | Group: | GS |
| Dependencies: |  | Priority: |  |  |  |
| Description: | Given a science target, KNASGUI must allow user to:* associate a new guide star with the target;
* modify an existing guide star’s rotation angle; and
* delete an existing guide star association.

Note that guide star coordinates cannot be modified.Guide stars are meant to be used with science targets.Guide stars are identified with the parameter type=guide in the option list.A rotation angle for the guider camera must be specified with guidepa=number, where number is in degree. |

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| ID: | 8 | Name: | Offset star | Group: | GS |
| Dependencies: |  | Priority: |  |  |  |
| Description: | Given a science target, KNASGUI must allow user to:* associate a new offset star with the target;
* modify an existing guide star’s rotation angle; and
* delete an existing offset star association.

Note that offset star coordinates cannot be modified.Offset stars are meant to facilitate acquisition, in the case that the science target is too faint for the guider. Offset stars are identified with the parameter type=offset in the option list.A rotation angle for the guider camera must be specified with guidepa=number, where number is in degree.Offsets in RA and DEC must be specified as raOffset=number and decOffset=number, where number is in arc-seconds of sky.While one offset star is often sufficient, a target can have multiple offset stars. |

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| ID: | 9 | Name: | Background Field | Group: | GS |
| Dependencies: |  | Priority: |  |  |  |
| Description: | A background field is specified by reference star, a rotation angle and a position on the guider camera.Given a science target, KNASGUI must allow user to:* associate a new background field with the target;
* modify an existing background field’s rotation angle; and
* delete an existing background field association.

A background field is identified with the parameter type=background in the option list.A rotation angle must be specified with guidepa=number, where number is in degree.Position of the reference star in the guider field must be specified with gxpos and gypos in pixel coordinates. |

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| ID: | 10 | Name: | Finding Chart | Group: | GS |
| Dependencies: |  | Priority: |  |  |  |
| Description: | To facilitate the selection of guide stars, offset stars and background fields, standard star catalogs should be used to find stars that are in the neighborhood of the science target.KNASGUI must allow user to:* perform a cone search of given radius or use a user-supplied catalog;
* retrieve DSS image or load a user-supplied FITS image;
* overlay catalog stars on DSS image;
* display catalog in table form;
* select star by clicking on a row in the catalog table; and
* select star by clicking on DSS image.
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# N&S Script Planning – Requirements

Each target in the star list can be associated with one or more N&S script. An N&S script is an XML file containing a sequence of instructions coordinating the telescope control system, guider subsystem and the instrument control system. The N&S script involves offsetting the telescope between the science field and background fields, as well as realigning the position of the guide star in the science field and background field stars.

Note: Managing star lists, targets and N&S scripts can be challenging. The link between targets and N&S script must be carefully managed. It is recommended that a certain name convention be followed and a directory hierarchy be used to organize the star lists and N&S scripts. A database to help organizing the star lists and N&S scripts would be useful but is not planned and is not a requirement.

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| ID: | 11 | Name: | Create | Group: | NSP |
| Dependencies: |  | Priority: |  |  |  |
| Description: | KNASGUI must allow the creation of a new N&S script.User must provide a new file path name. An extension “.xml” will be added if not present. A default file name prefix is offered to the user as “NSscript”. A sequential number is appended to the name if a file already exists.A new N&S script is created for a specific target. The first operation in the script is to check that the telescope is at the given target (within a given error tolerance). |

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| ID: | 12 | Name: | Load | Group: | NSP |
| Dependencies: |  | Priority: |  |  |  |
| Description: | KNASGUI must allow user to load an existing N&S script for editing.User must provide a file path name or it is chosen via a file selection dialog window.Once a file path is selected, the script is imported and displayed. |

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| ID: | 13 | Name: | Save | Group: | NSP |
| Dependencies: |  | Priority: |  |  |  |
| Description: | KNASGUI must allow user to save the current N&S script to a file under the same path name or another name.An N&S script always has a name since it is provided at creation time.If a new file name is used, the new name becomes the current name.Warning shall be given in case of overwriting an existing file. |

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| ID: | 14 | Name: | Edit | Group: | NSP |
| Dependencies: |  | Priority: |  |  |  |
| Description: | Once an N&S script is loaded, KNASGUI must allow user to:* view the content of the script;
* add new commands to the script;
* modify existing command parameters;
* reorder the commands; and
* delete commands.

KNASGUI must keep track of the exposure times for target and background.KNASGUI must provide context sensitive forms showing all the known and defined parameters for each command and the default values. The forms shall be auto-filled with calculated values if applicable (ie. offsets). The user can edit these values if desired. A reset option must be provided to revert any changes done by the user.KNASGUI must save changes in a regular interval no less than 5min. This prevents loss of data in case the user forgets saving or system crashes. |

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| ID: | 15 | Name: | List View | Group: | NSP |
| Dependencies: |  | Priority: |  |  |  |
| Description: | KNASGUI must provide a display showing available N&S scripts in the current directory and provide ways to navigate to other directories.KNASGUI must allow user to:* copy N&S scripts and
* remove N&S scripts.
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| ID: | 16 | Name: | Simulation | Group: | NSP |
| Dependencies: |  | Priority: |  |  |  |
| Description: | KNASGUI must provide simulation mode to execute the N&S script without communicating with the real telescope, guider subsystem or instrument.In this mode, simulated telescope, guider and instrument interfaces shall be used. The simulated telescope operates like an infinitely fast and precise telescope. The simulated guider shall provide simulated guider image frames at a user-defined rate. An image of simulated star should be on guider image. The simulated instrument shall provide an infinitely fast readout time.  |

# N&S Script Execution – Requirements

N&S scripts are executed by sending commands to guider subsystem MAGIQ, which in turn talks to the telescope control system. The operation of the telescope with N&S scripts must be coordinated with Observing Assistants, who are responsible for operating the telescope. There is a need for a synchronization mechanism to prevent multiple software applications controlling the telescope. However this is outside of the scope of this project. Until such a synchronization mechanism is implemented, coordination must be done verbally.

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| ID: | 17 | Name: | Load | Group: | NSE |
| Dependencies: |  | Priority: |  |  |  |
| Description: | KNASGUI must allow user to select an existing N&S script for execution.* If an N&S script is being edited, this script can be executed. In this case, the script must be saved to disk first.
* If no N&S script is being edited, an existing N&S script must be loaded.
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| ID: | 18 | Name: | Normal Run | Group: | SL |
| Dependencies: |  | Priority: |  |  |  |
| Description: | In the normal run, KNASGUI executes the N&S script according to the commands and their parameters.Only one instance of KNASGUI can execute a script at a given time. |

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| ID: | 19 | Name: | Setup Run | Group: | NSE |
| Dependencies: |  | Priority: |  |  |  |
| Description: | In the setup run, KNASGUI must allow execution of the script and at the same time allow modifying offset parameters as well as the guide star coordinates and guider camera rotation angle.In this run KNASGUI must display guider image and allow the user to select a guide star and to select any location in the image, which KNASGUI will translate into offsets to be stored in the script. Similarly, the user must be allowed to change the guider camera rotation and the display must be updated accordingly for verification. During setup, KNASGUI must allow exposure times to be temporarily set to a minimal value to speed up the setup sequence.  |

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| ID: | 20 | Name: | Display | Group: | SL |
| Dependencies: |  | Priority: |  |  |  |
| Description: | During the execution of the N&S script, the progress status of the current command and the accumulated exposure times for science target and background must be displayed. Also current waiting times and states affecting the command being executed should be displayed. |

# N&S Support – Requirements

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| ID: | 21 | Name: | Error Handling | Group: | SL |
| Dependencies: |  | Priority: |  |  |  |
| Description: | KNASGUI must handle errors that can occur during execution of an N&S script.* Error handling methods to be implemented are:
	+ Request user action
	+ Repeat command if applicable else abort
	+ Repeat condition check and allow user intervention
	+ Issue warning and continue
	+ Abort script and return to initial state
* The preferred error handling should be specified in the script.
* The default handling is to abort the script.
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| ID: | 22 | Name: | Logging | Group: | SL |
| Dependencies: |  | Priority: |  |  |  |
| Description: | KNASGUI must log:* all user actions
* all commands sent to MAGIQ
* all error conditions
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| ID: | 23 | Name: | Alarms | Group: | SL |
| Dependencies: |  | Priority: |  |  |  |
| Description: | KNASGUI must implement an interface to the telescope alarm system. |