

NICI Array Controller Top Level Requirements

NICI System Design Note # SDN1003

By Douglas Toomey 6/7/01 Revision 1.0

1.0 Introduction

This document will specify the top-level functional requirements of the NICI instrument Array Controller. This document will be used by software and hardware engineers as a basis for a more detailed specification of these interfaces.

2.0 Array Controller Overview

NICI is a dual array camera so the array controller issue, at the highest level, must deal with not only the normal requirements of running one array but also any special requirements that derive from two array operation. Additionally any special requirements in order to properly interface with the Gemini systems must be considered.

Ignoring the dual array issues momentarily, the NICI array controller requirements are basically those of a standard 1-5 micron broad and narrow band imager. NICI has quite small pixels (.018 arcseconds/pixel) resulting in fairly modest maximum frame rates (~5 Hz). The specific requirements will be described in detail in later sections but the point here is that each controller can be thought of as a standard array controller with no particularly demanding requirements.

When we consider dual array operation for NICI a new and important requirement does get added. Since NICI is a differential instrument, designed to difference images from two channels, it is important that each array see the same time slice of seeing history. When observing at two different wavelengths that are close to each other the NICI arrays must integrate in lock step. That is to say that the two integrations must be taken at the same time. The goal is for the integrations to be simultaneous to an accuracy of about 1 millisecond. This is determined by the time constant for change of the point spread function due to the atmosphere and AO corrections. One of the main drivers for making NICI differential is to sample the structure in the changing point spread function and to be able to cancel it. This means that the two array controllers must have a way to synchronize the integration start times to 1 millisecond.

Interfacing to the Gemini systems also adds new requirements. Since the NICI array controllers will run as embedded controllers, as opposed to being controller by an observer through a user interface, it must be thought of as a state machine. As an embedded controller state will be set, that state can be read back and a Go or a Stop operation can be executed. Since there will be no user interface to maintain the present state information, commands will have to be added that allow the state to be set and read. Another aspect of the instrument state is it's readiness state. NICI must be able to communicate to the Gemini systems that it is initializing, moving motors, in an error state

or in the ready and waiting state. This information all presently exists in the controller but commands will have to be added to allow remote query of the state and remote setting of the state en mass. We must also agree on the readiness states definitions. Finally we must ship the data to the DHS and the method and interface to accomplish this must be determined.

3.0 Functional Requirements

NICI array controller top level Functional Requirements

Must operate two 4 quadrant Aladdin type III style arrays

Connect to Gemini through a Socket for remote control

Must allow synchronization of readouts of the two arrays to 1 millisecond

Single subarray mode minimum size 8x16 placed anywhere in the array and reflected to all four quadrants

Global reset

Single sampled readout mode

Double correlated sampled readout mode

Multiple NDR noise reduction sampling mode

State set and state read commands

Populate the FITS header and ship the data to the DHS

Must operate in a standalone mode or under Gemini control in a remote mode

Must provide an image display in standalone mode

Must provide local storage for standalone mode

Must time stamp frames using Gemini supplied time board

Must have macro capability in stand alone mode

4.0 Performance Requirements

NICI Array Controller Top Level Performance Requirements

Read noise - the controller should not increase the device noise by more than 10%
A/D resolution – adequate to get two bits on the noise

Full frame coadd rate - 2 Hz required (10 Hz goal)

Full frame to disk rate – 2 Hz required (10 Hz goal)

Display frame rate stand alone mode – .5 sec to display frame desired