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New General detector Controller

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1 Introduction

1.1 Purpose

This document presents the glossary common to all the documents related to the ESO Next Generation detector Controller (NGC) project.

All the NGC project documents shall refer to this Glossary for the explanation of any term related to NGC.

1.2 Applicable and reference documents

Applicable and reference documents are listed in the "NGC Project Documentation" document, VLT-LIS-ESO-13660-3906.

2 Glossary

This glossary defines those terms (single words or phrases) concerning Software Engineering and Detector Control. The meaning of each term is carefully explained, focusing on its usage in the context of this specific document. Words, belonging to a term, which are enclosed in brackets, are implicit when no ambiguity can arise. Those words contained in the definition of a term and included also in the glossary, which are used with a specific technical meaning, are printed in italics. Entries are ordered alphabetically.

2.1 Acquisition Process

Software process on the NGC-LCU receiving the detector data and doing some on-the-fly pre-processing. The pre-processed data is sent as result **frame** to the RTD/IWS and is stored in FITS-file format.

2.2 Actor

An Actor is a role of an entity external to the system. Actors can be humans, machines, or devices

2.3 Back-End

Other side of the fiber-optic link connection to the **front-end**.

2.4 Bad-Pixel-Mask

A **frame** marking each pixel of a detector as either bad or good.

2.5 Chopping and Nodding

Chopping stands for rapidly switching between the source position and a nearby reference position in the sky: measuring alternatively the source plus the sky and the sky only. Subtracting these two images eliminates the sky noise. Chopping is often performed using a wobbling secondary mirror. Chopping is often used together with *nodding*, i.e., moving the whole telescope with an offset which is usually as large as the chopper throw, but in the opposite direction of the chopper throw. In this way, differences in the background radiation due to asymmetries in optics or spatial gradients in background emission are also cancelled. See [RD25], [RD26] and [RD27].

2.6 Class Diagram

A Class Diagram describes the types of objects in the system and the various kinds of static relationships that exist among them.

2.7 CLDC

Clock- and Bias-Voltage generator. This sets the voltage levels for all clocks and additional DC-voltage levels needed to drive an infrared or optical detector.

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2.8 Clock

One output line of the **sequencer** with two states (high=1, low=0).

2.9 Component

An implementation unit (aka physical software module).

2.10 Component Diagram

Diagram showing how Components are interconnected.

2.11 Deployment Diagram

Deployment diagrams show a system's physical layout, revealing which pieces of software run on what pieces of hardware.

2.12 DIT - Detector Integration Time (infrared)

Time between pixel-reset and the last read-out of the same pixel before resetting again.

2.13 DIT-Frame

A **frame** containing the result for one single **integration**.

2.14 Doxygen

Doxygen is a Documentation generator for C++, C, Java, Objective-C, Python, IDL (Corba and Microsoft flavors) and to some extent PHP, C# and D. It runs on most Unix systems as well as on Windows and Mac OS X.

2.15 Drift Scanning (optical)

It consists of one single integration. During the integration the shutter - if present - is kept open, the charges on the CCD are continuously shifted along the parallel registers, and read out (with the read-out mode determined by setup parameters).

2.16 Dwell-Time

Length of one **state** (in ticks of 10 ns).

2.17 Enterprise Architect

Enterprise Architect is a UML 2.0 modeling tool. It supports all 13 UML 2.0 diagrams, as well as an extensive range of features for Software Development, including Round trip Code Engineering, Database Modeling, Requirements, Interface Design, Document generation, Model Driven Architecture (MDA), HTML reporting.

2.18 Exposure

The definition of an exposure slightly differs in the infrared and the optical cases.

2.18.1 Exposure (infrared)

Data taking and storing period lasting for several consecutive infrared **integrations**.

2.18.2 Exposure (optical)

Set of actions from the setup of the detector to the actual data taking and storing. Multiple **integrations** may be included in a single exposure

2.19 Exposure time

The definition of the exposure time slightly differs in the infrared and the optical cases.

2.19.1 Exposure time (infrared)

Time needed for all **integrations** of one infrared **exposure**.

2.19.2 Exposure time (optical)

time between the open and close of the shutter. In case of a **dark exposure** it's the time between the **wipe** (or the last readout if there is no wipe) and the readout.

2.20 Exposure types

2.20.1 Normal exposure

It has the following characteristics:

It consists of one single integration.

The CCD is normally wiped before starting a new exposure.

During the integration the shutter, if present, is kept open.

After the integration, the CCD is read out. The read-out mode is determined by setup parameters.

Image data are stored in a FITS file, using the "image extension per chip" format, as specified by [AD37].

2.20.2 Dark exposure

It consists of an exposure where the shutter is kept closed.

It has the following characteristics:

It consists of one single integration.

The CCD is normally wiped before starting a new exposure.

During the integration the shutter is kept closed.

After the integration, the CCD is read out. The read-out mode is determined by setup parameters.

Image data are stored in a FITS file, using the "image extension per chip" format, as specified by [AD37].

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2.20.3 Bias exposure

It consists of a 0 integration time **Dark**.

It has the following characteristics:

It consists of one single integration.

The CCD is wiped, then read out. The read-out mode is determined by setup parameters.

Image data are stored in a FITS file, using the "image extension per chip" format, as specified by [AD37].

2.20.4 Flat Field exposure

It is **frame** used to normalize individual pixel sensitivity.

In the optical it consists of a Normal exposure, with the chip exposed to a uniform flux of radiation.

2.20.5 LedAndShutter exposure

It consists of a **Normal** exposure (shutter open), with the chip exposed to the radiation generated by a LED (which is located between the chip and the shutter).

2.20.6 Led exposure

It consists of a **Dark** exposure (shutter closed), with the chip exposed to the radiation generated by a LED (which is located between the chip and the shutter).

2.20.7 Multiple or Multi-step exposure

It consists of more integrations. They may have the same or different duration.

The CCD is normally wiped before starting a new exposure (determined by the setup).

During each integration the shutter, if present, is kept open.

After each integration, excluding the last one, the exposure is automatically paused (the shutter, if present, is closed)

During pauses between consecutive integrations, rows may be shifted on chip (determined by the setup).

The next integration is started with a CONT command.

After the integration, the CCD is read out. The read-out mode is determined by setup parameters.

Image data are stored in a FITS file, using the "image extension per chip" format, as specified by [AD37].

2.20.8 Burst or Drift Scanning exposure

It consists of one single integration.

The CCD is normally wiped before starting a new exposure (determined by the setup).

During the integration the shutter - if present - is kept open, the charges on the CCD are continuously shifted along the parallel registers, and read out (with the read-out mode determined by setup parameters).

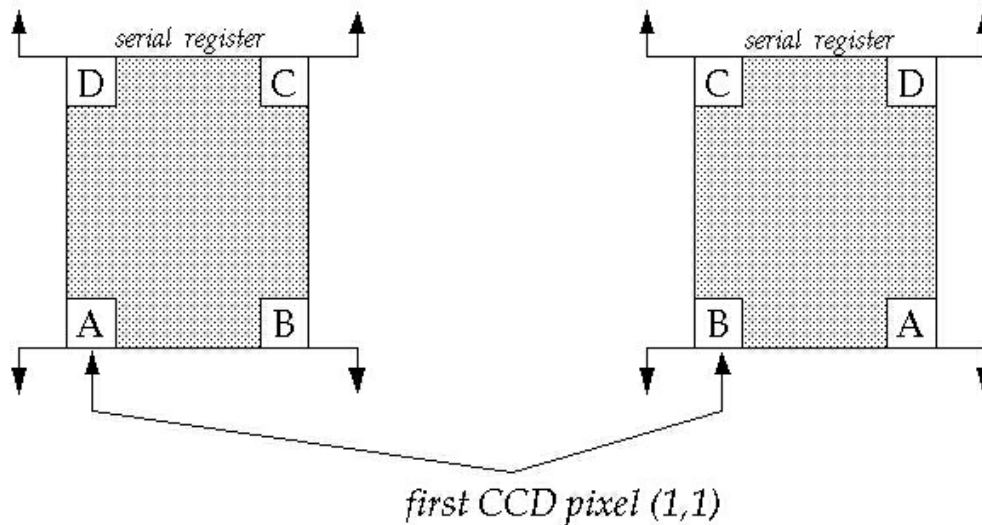
Image data are stored in a FITS file, using the "image extension per chip" format, as specified by [AD37], where each extension contains an amount of data lines corresponding to the physical dimensions of the chip.

2.21 First Pixel (optical/CCD)

The first pixel of a CCD is the pixel on the bottom, left corner, assuming the following assumptions:

- 1) looking at a CCD from the illuminated side,
- 2) the serial registers define the horizontal direction,
- 3) the output register defined by the manufacturer as the first output (usually called A), is set at the bottom.

Coordinates of the CCD first pixels are 1,1.



2.22 Fixed-Pattern (= Bias-Frame?)

A **frame** used to compensate individual pixel offsets.

2.23 Frame

A two-dimensional data set arranged in pixels containing the detector data.

2.24 Front-End

Hardware part which is close and directly connected to the detector. Only connection to the outside world is through fiber optic link(s).

2.25 Half-Cycle (HCYCLE)

The half of a chopping cycle (i.e. either "on sky" or "on object"). The data (or the mean value of the data) taken during one half cycle is stored in a separate **frame** (HCYCLE-frame).

2.26 HCYCLE1,2-FRAME

Two **frames**, each containing the mean of all chopping **half cycles** on either object or sky for all **integration** during one infrared **exposure**.

2.27 High Time (HIT) resolution imaging and spectroscopy

When operating a CCD in the HIT mode, a mask with a slit covers the CCD chip. During the exposure, the charges on the chip are shifted along the parallel register, then the shutter is closed and chip is either readout (*One Shift Mode, HIT-OS*) or the charges are shifted back along the parallel registers, the shutter is reopened and the shifting of the charges on the CCD is then restarted (*Periodic Shift Mode, HIT-PS*), superimposing several images or spectra and improving the signal-to-noise ratio. See [RD23].

2.28 INT-Frame

A **frame** containing the mean of all **integrations** of one infrared **exposure**. This is the standard result **frame** produced by the **acquisition process(es)**.

2.29 Integration

The definition of integration slightly differs in the infrared and the optical cases.

2.29.1 Integration (infrared)

The state of the detector between two consecutive resets.

2.29.2 Integration (optical)

Photon collection on a detector.

2.30 Interaction Diagram

Interaction Diagrams describe how groups of objects collaborate in some behaviour.

2.31 Module

2.31.1 Hardware Module

Electronics unit like front-end Basic Module and AQ Module

2.31.2 Software Module

Assembly of routines, classes, libraries and processes which forms a container for a certain functionality or hierarchical level inside a software package. Unit to be archived with CMM.

2.32 Monitor

Hardware unit to monitor selected clock- and/or data-lines on an oscilloscope.

2.33 Overlapping windows

Windows with pixels in common.

2.34 Pattern

Sequence of (clock-) **states** to perform a certain action on the detector (*Reset, Read-Pixel, Next-Line, etc.*)

2.35 Sequence

A sequence of **patterns**.

2.36 Sequence Diagram

Most common form of Interaction Diagram, capturing the behaviour of a single scenario (system startup/shutdown, exposure, etc.), showing a number of example objects and the messages that are passed between these objects within the use case.

2.37 Sequencer

Hardware unit, which generates programmable timings to read-out infrared or optical detectors. The timings also contain the data conversion strobes and utility signals for oscilloscopes and external devices.

2.38 Sequencer Program

Program structure (with *LOOP*- and *EXECUTE*-instructions) to create various **sequences of patterns**.

2.39 (System) Package

A logical grouping of elements, used to model the architecture.

2.40 Software Package

Assembly of **software modules**.

2.41 State

State of all **clocks** of one **sequencer** hardware unit at a certain time. Each state is stored in one word in both the sequencer Low- and High-RAM.

2.42 STDEV-Frame

A **frame** containing for each pixel the standard deviation of all **integrations** during one infrared **exposure**.

2.43 Use Case

A use case is a description of both the major functions that the system will perform for Actors, and also the goals that the system achieves for those Actors along the way.

2.44 Va-et-vient

Small signals affected by temporarily varying bias or gain can be determined more accurately by rapidly switching between the signal of interest and a reference (*chopping*). “Va-et-vient” makes use of the fact that on CCDs charges can be clocked in *two* directions, thus allowing to consecutively obtain (sky + object) and (sky) exposures on the same frame without having to read out each sample immediately. The important point is that both (object + sky) and (sky reference) are always observed quasi-simultaneously through the identical optical train, with identical slit/aberration/distortion/flexure/... properties, on identical CCD pixels, which exhibit essentially the same flat-field and fringing behaviour. See [RD24].

2.45 Wipe (optical)

Sequence run on a CCD in order to remove spurious charges before an **integration** starts.

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