TECHNICAL REPORT n. 136

AVU GWP-S-340-50000(20000): Astrometric Instrument Model

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Abstract

This document is the reference for the AIM software system development attempting to cover all relevant activities from now until the Gaia launch and through satellite operations. In this respect the document is foreseen to be in constant development with an anticipated issue rate one per year. This first issue gives a first overview of the AIM system within the Astronetric verification unit (AVU), recalling on the original motivations for its realization (as formulated in 2006), the changes occurred during the following two years and the actual AIM structure and goals. It also describes what it will do and how, the AIM software modules and subsystems in detail, pointing out the most critical parts from the point of view of the scientific treatment of the Gaia data.

1 Introduction

At the beginning, the Astrometric Verification Unit included also a package devoted to the IDT processing verification: GWP-S-340-20000. It had to consider those aspects of the IDT which were considered most critical for the astrometric error budget. The initial study had to identify the critical IDT steps based on their contribution to the error budget and confirmation was foreseen only on these steps (i.e., a complete alternative IDT processing chain will not be developed). While the final list of possible items to be investigated was to be determined, the following would have to play a critical role: image parameters, PSF/LSF calibration, CCD calibration, and transit-level attitude diagnostics. For those reasons an alternative centroiding algorithms and PSF/LSF - CCD calibration chain were foreseen.
From 2008 the alternative raw data processing package (GWP-S-340-20000) becomes one of the AIM system modules so that the GWP-S-340-20000 was no more present as stand-alone package in the AVU work breakdown structure.

2 AIM overview

The Astrometric Instrument Model is the system in charge of processing the Astro data telemetry in order to monitor and analyse the Astro instrument response over the mission lifetime.
The AIM system is a fundamental component of the technical and scientific verification of the overall Gaia astrometric data processing, and is developed within the context of the Astrometric Verification Unit (AVU) of CU3 (see Figure 1). Deployment and execution of the operational system will be done at INAF-OATO.

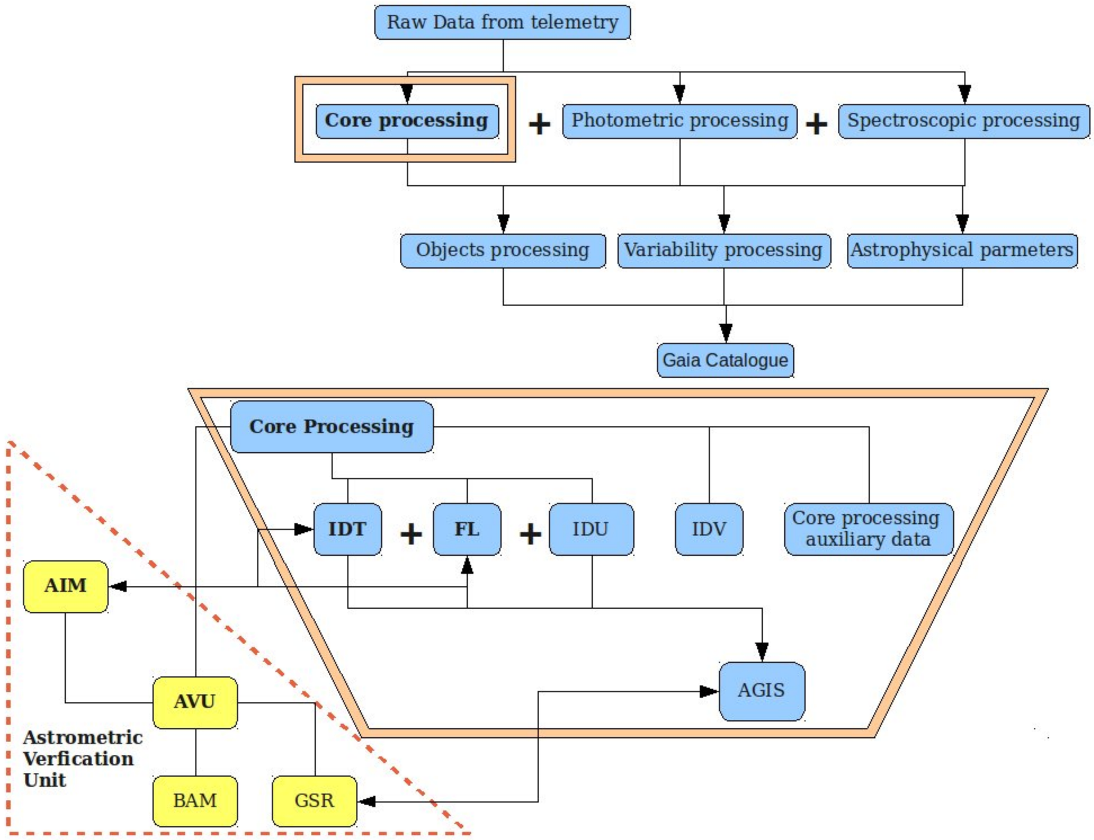

Figure 1: Overview of the Gaia Processing chain with particular attention to the Core Processing andAstrometric Initial Data Treatment tasks. The AVU unit is shown within dashed-line triangular box.

AIM is devoted to the monitoring and diagnostics of the astrometric instrument response during in-flight operations. The goal is the identification of an efficient set of global (effective) parameters for representation of the instrument signature of the data, in spite of the probable degeneration of the real physical parameters. This should optimize the parameter estimation process within the core processing with respect to computation load, precision, or both. The module will analyze the impact on the data of perturbations to the instrument and operation parameters (optics, attitude, detection system), including the variation from ground to orbit, aging and noise. AIM will compare the readouts with the implemented models in order to verify the behavior of the Optics, CCD device and interpret the data using a suitable physical model.
Realistic models of the instruments are fundamental to achieve a suitable knowledge of the Payload behavior. It is our intent to find out which effect is important and needs to be simulated and which are not, performing an accurate analysis on the instrument characteristic. AIM will use the instrument modeling tools developed in CU2, and develop appropriate analysis tools.

The WP will produce optimal calibration and diagnostic procedures to be then included in the core processing.

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AVU instrument model will be very physical, technically-motivated. It will work on all necessary timescales (short, medium and long term), which we deem useful to fulfill the AVU mission, i.e., verification of the quality of the crititical items within the astrometric error budget.
For example, the shortest time scale action of AIM is probably the comparison to the IDT centering algorithm on the actual pixel data from single CCD transits.
It is understood that probably several instrument parameters are degenerate; therefore this WP deals mostly with appropriate effective parameters. Identification of such effective parameters is the objective of the forward analysis on a set of perturbed configurations.
During operations, the estimate/calibration procedures will provide the most likely representation of the instrument by the same set of the effective parameters (backward analysis)

We can identify various phases through which the work will go on.
The initial phase will consist in the identification of which and how many parameters could affect the mission performance, in the identification of the perturbation range of the relevant instrument parameters.
Then we will perform the exploration of the parameter space by construction of the AF data corresponding to the selected perturbation range for simulations and analysis of actual data from ground-based laboratories or satellite, and search for effects relevant to the astrometry. We identify and estimate the effects with the resulting development of estimation/calibration procedures: e.g scale effects, focal length changes, differential telescope effects, chromaticity parameters, geometric CCD calibration, instrument astrometric signature.

2.1 AIM System – Why's:

Here we list the main reasons for the AIM system

- verification of the performance of specific parts, those identified as being critical to the astrometric error budget, of the IDT pipeline (i.e., psf modeling, CDM, location estimation,..)
- astrometric instrument model maintenance and operation;
- calibrations of the SM and AF parts of the focal plane;
- Understanding the parameter degeneration of the relation linking the observations to the instrumental behavior, and optimize the estimation process at the CCD and fieldofview crossing level (forward/backward analysis).
- Critical for the system is the definition and maintenance of a <u>physical instrument model</u> fitting the science data, and able to accommodate <u>non nominal configurations</u>.
- Precise modeling of the astrometric response is required for optimal definition of the data reduction and calibration algorithms, and to ensure highest possible sensitivity to both the instrument and the astrophysical sources.

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2.2 AIM System - How

The AIM system is a collection of software modules, each dedicated to perform a particular analysis of the selected data set with the goal to extract information about instrument health and Astro instrument calibration parameters during in-flight operations. AIM gathers several tasks with the goal to perform checks on the correct functioning of the Astrometric instrument.

There are five main software modules, each pertaining to the five activities AIM will perform as shown in Figure 2. The first module is in charge of the basic processing to convert the raw data into the actual measurement and estimate the effective parameters. This process includes modules devoted to the generation of the reference image profile through the AIM models and the calibration/knowledge of the Astro instrument (i.e. the astrometric instrument model module and the parameters extraction module). The next three fundamental parts are the Monitoring package, the Diagnostic and Analysis package, and the Physical Instrument simulation package, which correspond to the main AIM system activities.
The fifth module, the Comparison package compares the AIM outputs with the FL results in order to have a cross-check on the behavior of the instrument.

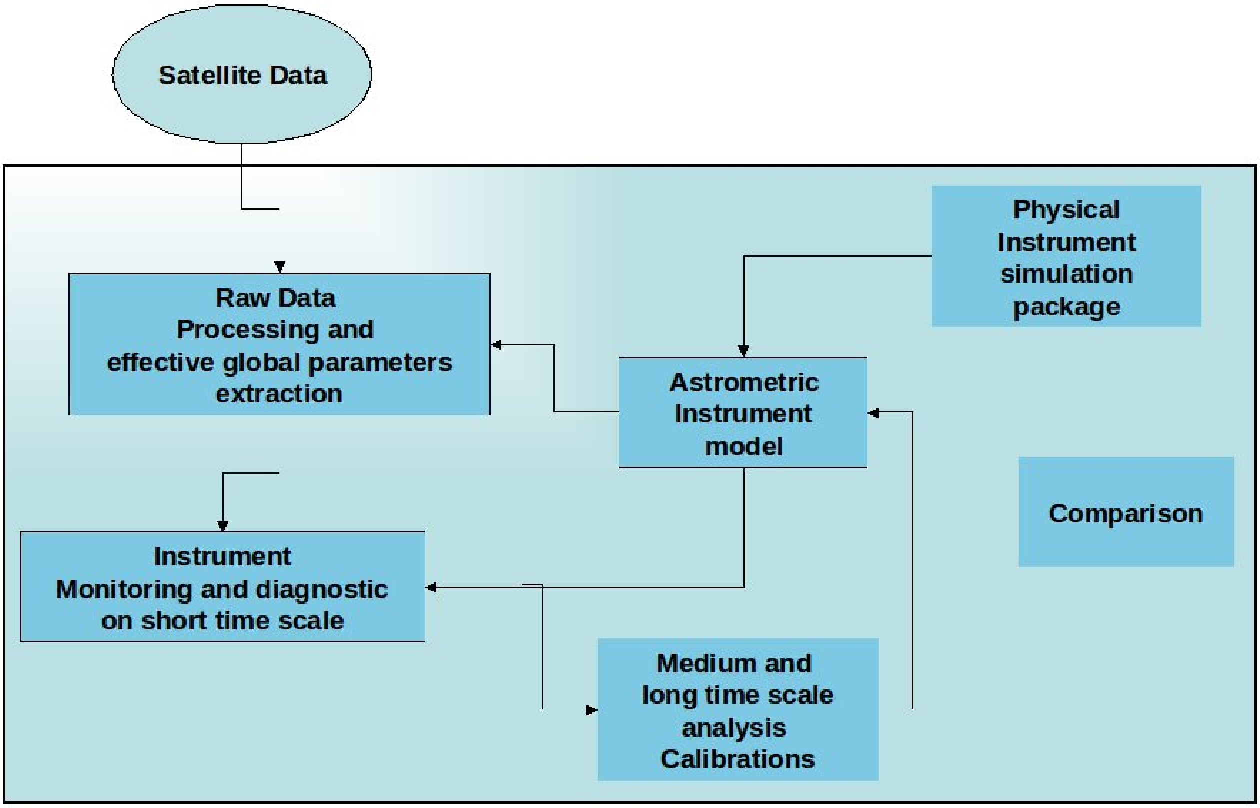

Figure 2: Overview of AIM/AVU data analysis software system activities

A set of dedicated algorithms and procedures for the comparison to IDT and FL(Detailed FL) results is defined and implemented. Also a proper set of parameters over which to perform the comparisons is identified.
The system also provides a number of graphical and interactive tools to monitor, analyse, and control the individual processes and the status of the AIM data processing.

Within AIM we have also foreseen additional modules devoted to the processing of the measurements for purpose of calibration during both commissioning and operation. For example the software will tackle the effects of focal plane image displacement and deformation, EFL monitoring, windowing and binning calibration.

Except for very specific parts, AIM is implemented in the Java programming language. Some of these packages contain almost exclusively interfaces, the implementation of these interfaces are found in corresponding packages that share their names but incorporate the "impl" suffix.

The basic processing software module has not been organized in a package but in a set of classes (*RDProcessing* and *RDProcessingimpl*). The raw data processing includes modules devoted to the generation of the reference image profile through the AIM models and the calibration/knowledge of the Astro instrument (classes *aimModelization*, *physicalInstrModel* and *CalibrationAssistant*). Finally, the package Util contains all the graphical utilities.

AIM software modules	Java interfaces	Java implementations
the raw data processing	avu.aim.RDProcessing	aim.RDProcessingImpl
the Monitoring package	avu.aim.aimMonitoringDiagnostic	aim.aimMonitoringDiagnosticImpl
the Physical instrument Simulation package	avu.aim.physicalInstrModel	aim.physicalInstrModelImpl
the Diagnostic and Analysis package	avu.aim.aimDiagnosticAnalysis	aim.aimDiagnosticAnalysisimpl

Tabella 1: How: AIM software modules

As **input data** AIM requires:

- Raw image data (after telemetry is unpacked) for well-behaved stars (single stars for G<16, bright stars 8<G<13), and selected sets of faint stars in SM/AF;
- detection statistics performed by IDT and IDT elementary data, such as image location and widths, magnitudes, etc.;
- Industry/Simulations: instrument models and instrument calibration data (on-ground and in-flight respectively);
- First Look (FL) health instrument and diagnostic outputs to perform comparisons.

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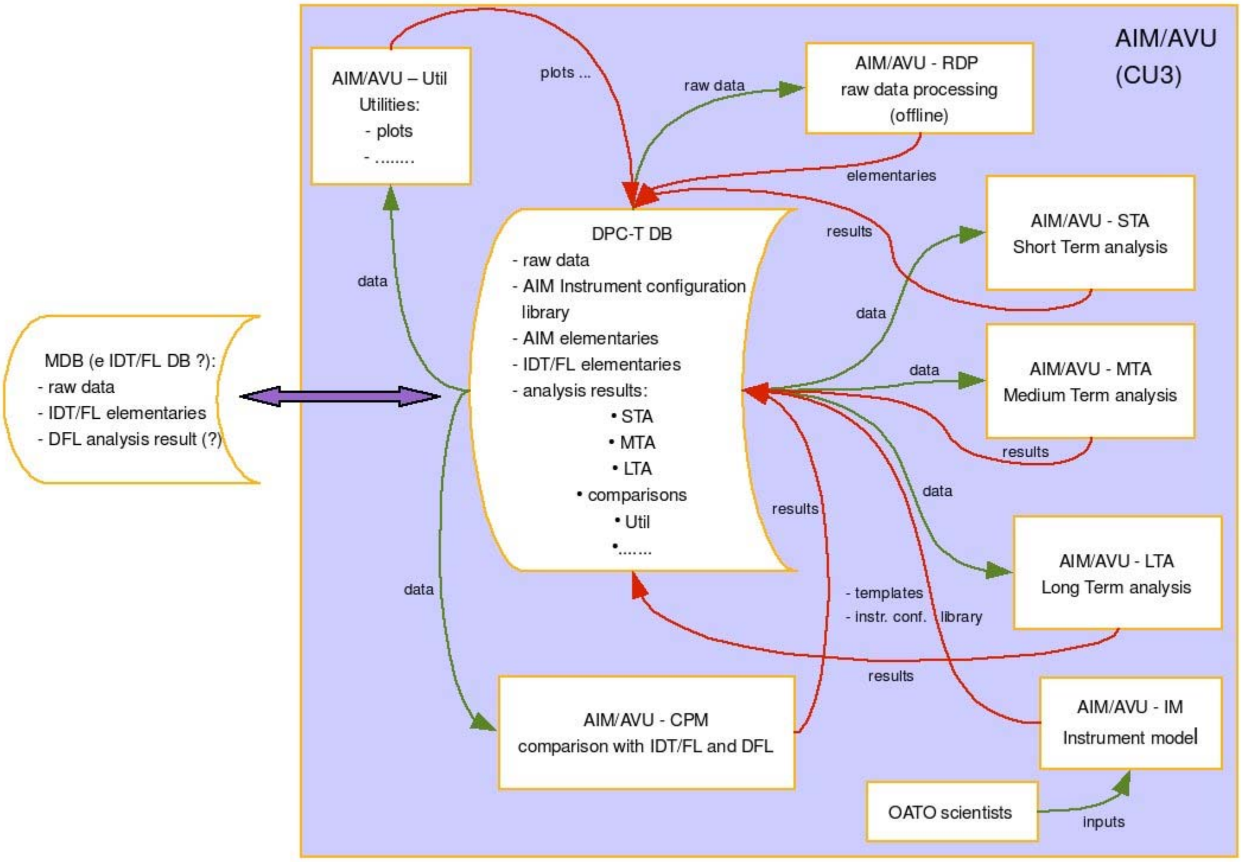
The **output data** consist of:

- results produced by the software modules in charge of monitoring the astrometric instrument response over time and performing the medium and long term analysis with the aim to derive (calibrate) the best values of the coefficients of the analytical functions, which form the different parts of the instrument response model;
- for the monitoring task the output is provided in the form of reports with graphs, plots, comments that will be distributed to interested parties within the DPAC;
- the output of the medium and long term analysis is the refinement of the astrometric instrument model and instrument calibration parameters;
- intermediate output consisting of the extraction and calculation of the effective parameters used in the monitoring and analysis modules.

2.3 AIM Flow chart description



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Tasks

- Identification of the instrument parameter perturbation range;
- Exploration of the parameter space by construction of the AF data corresponding to the selected perturbation range;
- Identification of the astrometric or image variation effects
- Develop data analysis methods;
- Develop data analysis algorithms;
- Develop estimate/calibration procedures:
  - Scale effects, i.e. focal length changes
  - Differential telescope effects
  - Chromaticity parameters
  - Geometric CCD calibration
  - Instrument astrometric signature
- Develop data analysis software;
- Implement data analysis software;
- Maintain the data analysis software;

  - Merit statistics used to process the raw data and performed data analysis (methods, algorithms).
  - AIM instrument configuration library : ccd effects, radiation damage effects, optical, mechanical thermal perturbation effects,.
  - [Possibility to include treatement of charge injection.]
  - Identification of the astrometric or image variation effects due to differential optical contribution for ``calibration`` test

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3 AIM/AVU system: WP list

In this section we list the different sub-workpackage which AIM system is divided in.

GWP-340-50000 (+20000): AIM/AVU			
50100	Management & coordination		
	50200	Produce software system	
	50300	Develop/Integrate components & algorithms	
		50310	Develop, Implement and updating of RDProcessing SW infrastructure
		50320	Develop, Implement and updating of PhysInstrMod SW infrastructure
51000	AIM raw data processing tool		
	51100	Radiation damage treatment	
	51200	PSF/LSF profile model 1D and 2D windows	
	51300	Image parameter extraction	
52000	AIM simulator tool		
	52100	Optics package	
		52110	Sensitivity analysis and no nominal configurations
	52200	Detector package	
	52300	Geometry contributions package	
	52400	Operations package	
	52500	Attitude package	
53000	AIM Astronomical Instrument model tool		
	53100	Local response	
	53200	Focal plane variation	
	53300	Fields of view correlations	
54000	AIM Instrument monitoring tool		
		54001	Instrument monitoring task 01
		54002	Instrument monitoring task 02

		540NN	Instrument monitoring task NN
55000	AIM diagnostic tool		
	55100		Short term analysis tool
	55200		Medium term analysis tool
	55300		Long term analysis tool
56000	AIM calibration tool		
57000	AIM comparison tool		

3.1 Whats: RDProcessing and link to calibrations

The current strategy implemented in AIM for processing the raw data from the astrometric CCD and the extraction of image parameters follows that adopted in IDT, with the one exception of the model adopted for PSF/LSF free from radiation damage. On the other hand, the charge distortion model (CDM) implemented for predicting the damaged PSF/LSF profiles (from the no radiation calibrated effective PSF/LSF) is, for the moment, the same as in the baseline data processing chain.

Indeed, the AIM subsystem has been foreseen to perform also alternative processing of those aspects of IDT, which are most critical for the astrometric error budget (image parameters, PSF/LSF calibration, CCD calibration, transit-level attitude diagnostics) including the radiation damage treatment. However since radiation damage treatment is complex, DPAC has concentrated its resources in developing a robust and accurate scheme for the successful treatment of radiation damage in the baseline processing chain. The CTI degradation, in fact, highly influences the profile of the effective PSF/LSF and the background estimation with deleterious effects on the astrometric accuracy. Therefore it is of primary importance to mitigate, better compensate, for the CTI degradation effects on science data, which could introduce systematics of up to hundreds μas in the image true location.

The image parameters extraction is closely related to the PSF/LSF calibration task and to the CCD transit history analysis task. Indeed, different centroid algorithms show different sensitivities to errors in PSF/LSF calibration. Because of that, an accurate definition of the PSF/LSF template is demanded.

We implemented a raw data treatment using a simulated PSF/LFS library that takes into account realistic non nominal electro-optical configurations (radiation damage free) and the analytical PSF/LFS model in Gai et. al 2010. The functional scheme of the approach is shown in Figure 3.

Accumulated data

The stellar candidates used as calibrators for retrieving the non nominal configuration have to be point-like bright sources (in the interval 13<G<16), show no saturation to avoid the operation of gates, be photometrically stable, and have well known colors. For the selected objects we need the best possible charge damage model and, as additional request, be far from a charge injection event. Last but not least we need accurate background measurements. We will utilize data accumulated over few transits (few thousand objects) and belong to a sufficiently large astrophysical sample.

We wish to remark that several temporally coherent sets of accumulated data, e.g. brighter sources (G=10 - 13), will be used to perform different diagnostics.
We address one item of particular interest for IDT and for the consequences it has on the astrometric error budget, i.e., the treatment of bright objects, which will constitute the bulk of the well-behaved celestial reference points utilized in the core processing (sphere solution). Operationally the term "bright" refers to objects of magnitude G < 16. The search for the best possible centroiding performance is of course critical for these stars. On the other hand, saturation starts at G = 12.8 and will become severe for those objects in the brightest magnitude bin of interest to Gaia (7<G<10).

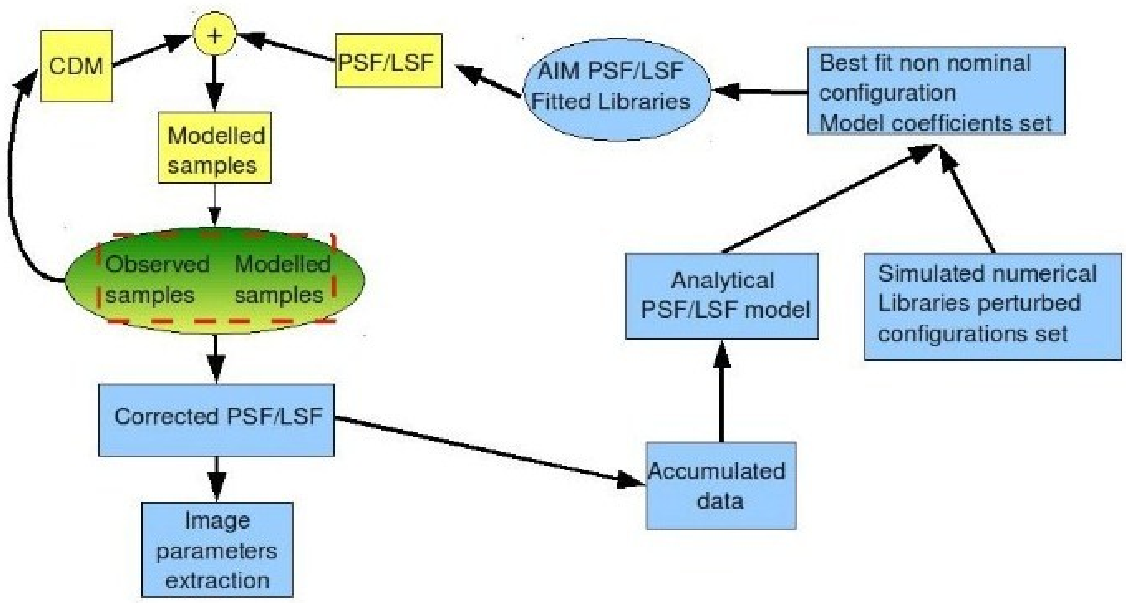

Figure 3: Schematic view of the raw data processing and its link to the calibrated PSF/LSF profile.

Java architecture

The module process the subset of the raw data (AstroObervations) relative to the SM and AF part of the focal plane, estimates the global effective parameters (eg., location, flux, FWHM and higher moments, and corresponding errors), and feeds them to the AimElementaries class. The input to the module is represented by AstroObservation and AstroElementary, and comes from IDT outputs. The output is represented by the class AimElementaries and AimObservations. Input and output are

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both managed by the AvuAimCoordinator which takes care of handling data from and to the local Data Base. Thanks to this arrangement, RDProcessingimpl, the main class of the module, is only concerned with actual processing; RDProcessingImpl implements the interface RawDataProcessingIntf (this choice has been made to allow flexibility). This incapsulation hides to the outer caller the details of how the raw data are processed.

Note that the only class that is supposed to use RDProcessingIntf is the AvuAimCoordinator class that owns a RDProcessingIntf object. The RDProcessingimpl class is supported by the classes GlobalParameterExtraction, CalirationAssistant, and AimModelizationImpl. The adopted modularity allows a reasonable level of flexibility necessary to take into account the different steps and algoritms for the effective parameters determination and for dividing the process into simpler steps to minimise the risks of an execively complicated architecture. The GlobalParameterExtraction class is used to calculate the image effective parameters useful for the AIM software system to perform monitoring diagnostic and diagnostic analysis.

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3.2 What's: AIM simulator tool

3.2.1 Optical aspects

The optics are one of the crucial elements to reach the Gaia performance. It is needed to investigate the behavior of the optical elements under mechanical or/and thermo-elastic perturbations or ageing degradation.
Also the commissioning phase during which the optics realignment will be realize is crucial, so it is needed to know the in-flight realignment scheme to be able to investigate the possible recoils over the mission goals.
We will access the description of the system geometry and of some physical aspects such as the thermal and mechanical evolution of the structure, the evolution of the optical quality of mirrors, the sensitivity of the telescopes alignment to aging.
The characterization of the mirror reflectance is demanded for the full understanding of the expected intensity distribution at focal plane level.
Example one: we can test what happens to Gaia signal if the reflectivity value moves away from the nominal one by a four percent only in one part of the mirror.
Example two: It could be useful also to take into account two-mirrors perturbations, which don't have plain reference to the one-mirrors perturbations
Needs to analysis the image properties for nominal and perturbed instrument configuration:

- WFE map
- Distortion map
- PSF and MTF
- Polarization contribution
- Stray light contribution
- Differential effect between telescopes and contribution to scan velocity over the FOV
- Chromaticity distribution

What we have to do?

- Telescopes modeling.
- Detailed description of the realistic optical response of the nominal configuration on SM and AF
- Generation of independent distortion and pupil map;
- Aberration description (WFE) for several positions on each CCD;
- SM/AF PSF libraries for several positions on each CCD;
- Analysis of some peculiar aspects as the asymmetry of AF – effects on the image integration (aberrations compensation, chromaticity);
- Analysis of the focal plane common mode variation and of differential effects between the two telescopes;
- Build the mapping equation relating focal plane coordinates with pixel position.
- Study of tolerances on nominal configurations and determination of the sensitive degrees of freedom versus possible misalignments.
- Analysis of differential effect between the two telescopes under perturbation of alignment: e.g the contribution of EFL residual differences on astrometry measurements.

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- Simulation of realistic degraded performances. Contribution to scientific data and astrometric accuracy.
- Analysis of effects due to scanning velocity variation (AL and AC) on final data.
- Simulations for polarization effects.
- Study of the stray-light contribution to the performance degradation: e.g. effect of bright objects (within the FOV) on weak ones.
- Model of instability of the optics (e.g. basic angle variations) and temporal evolution.
- Analysis of sensitivity to the thermo-mechanical (TM) stresses: simulation of the system behaviour under TM perturbations. TM evolution of the system.
- Polarization effects variation as a consequence of mirror quality deterioration and scattering changes.
- Analysis of degradation/aging aspects (e.g mirrors quality changes, throughput variations) and fine effects on astrometry during the mission.
- Residual differential effects under more complex perturbed configuration (TM contribution and attitude contribution).
- Evolution of stray light diffusion with system aging or alignment changes by effect of TM perturbations.

3.2.2 CCD aspects

The goals of the CCD model work package is to provide high performance simulation of the individual and collective properties of the Gaia detectors and the proximity electronics such as non-linearity, saturation, CTI, pixel-to-pixel variation, etc.

Various CCD types are in fact required for the instruments on the GAIA payload. The baseline CCD type is the AF CCD for the ASTRO focal plane instrument. The photometry aspects of the Gaia system have since been redefined to use CCDs that are variants of the AF CCD. These are known as the Red Photometer (RP) and Blue Photometer (BP) devices.

The effects of CCD characteristics (at individual and assembly level) are introduced into the signal model by parameters related to geometry (position, orientation) and electro-optical response (MTF, QE, gain, RON). MTF and QE are wavelength dependent and must be introduced in the composition of monochromatic PSFs, whereas geometry, RON and gain only need to be taken into account in the definition of sampling and detection of the polychromatic PSF. The implementation is based on progressive improvement of the corresponding algorithms and update of the relevant parameters, also based on the results from device characterization and consequent evolution of the CCD physical model. Detailed description of the local deffects impact and of TDI operation will similarly be implemented, likely at a later stage, by means of algorithms applied at the appropriate stage of construction of the detected signal, also taking into account possible magnitude-dependent factors.
On-ground characterization of individual CCD response, in particular with respect to noise and charge transfer efficiency (CTE) degradation as a function of the radiation damage expected in the Gaia operating environment, is crucial to define a faithful algorithm representation of the detector model, suited to the diagnostics implemented in the data processing.

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What we have to do?

The model will take into account at least all the CCDs and proximity electronics characteristics introducing disturbing effects into the signal model at individual and assembly level:

- geometry (position, orientation)
- electro-optical response (MTF, QE, gain, RON)
- non-linearity, saturation
- CTI, radiation and charge injection effects (deferred charge, charge loss, electronic bias)
- pixel response non-uniformity (PRNU)
- variation inter and intra CCD, aging
- sensitivity variations over the focal plane
- AC non uniformity of the saturation at CCD level (FWC)
- The model will implement a detailed characterization of individual CCD response and description of TDI operation by means of several detailed models:
- Modulation Transfer Function model
- High accurate investigation about the radiation damage and CTI degradation, radiation and charge injection effects (deferred charge, charge loss, bias) to define a suitable model
- Prompt-particle events impacts models
- Saturation/non-linearity models (at pixel level and read-out register)
- Noise models
- Fringing model
- Defaults and aging models

Geometry variations

- CCD position and orientation: nominal FPA geometry
- tolerancing of the FPA geometry (CCD position and orientation)
- expected stability of power supply and dissipation at CCD level
- expected thermal displacement of CCD
- mirrors position and orientation

Operations

- CCD-Field transformation
- Transit composition
- windowing
- PSF/LSF modeling
- Base Angle

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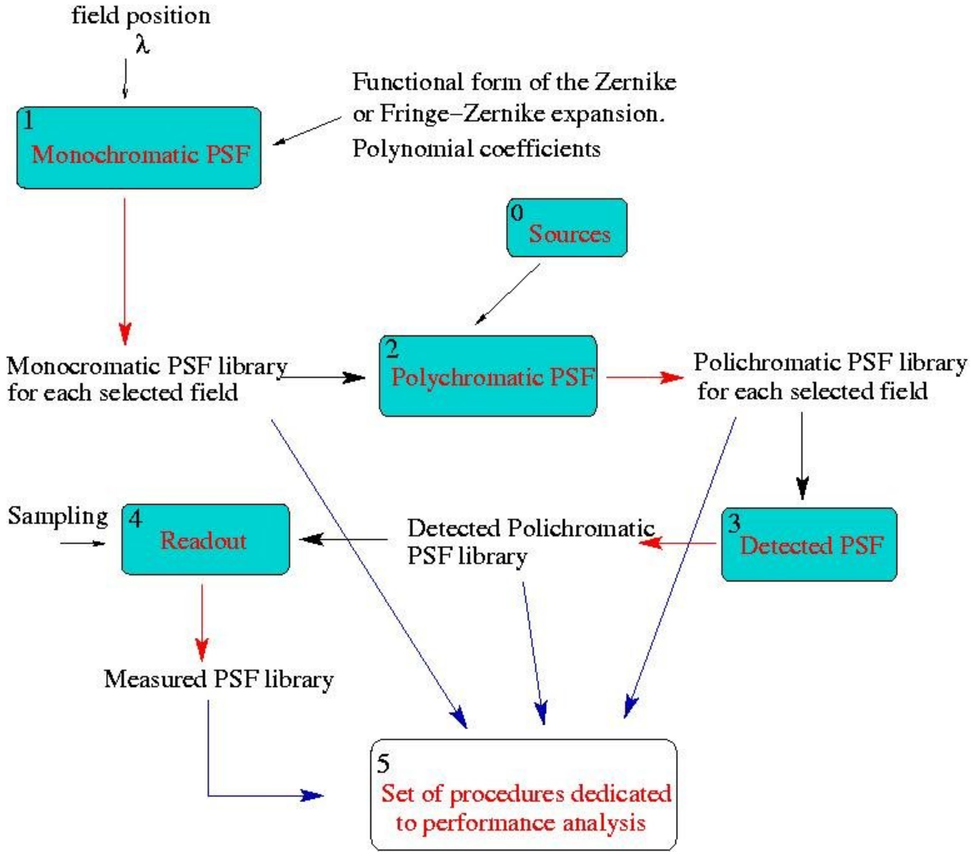
3.2.3 Signal processing chain



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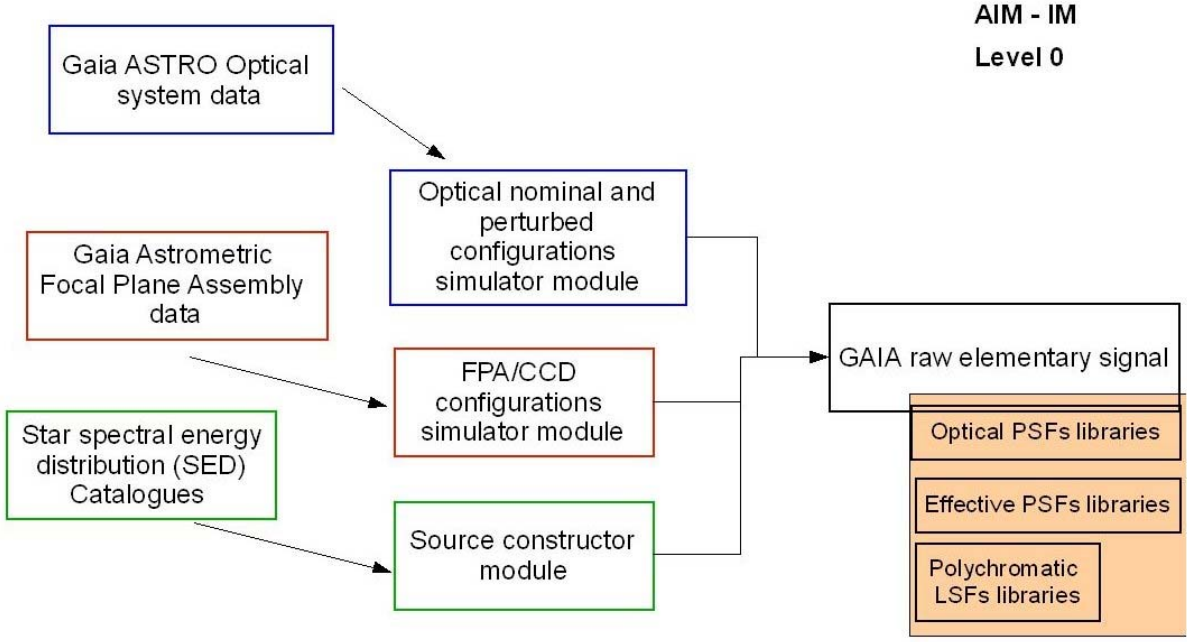
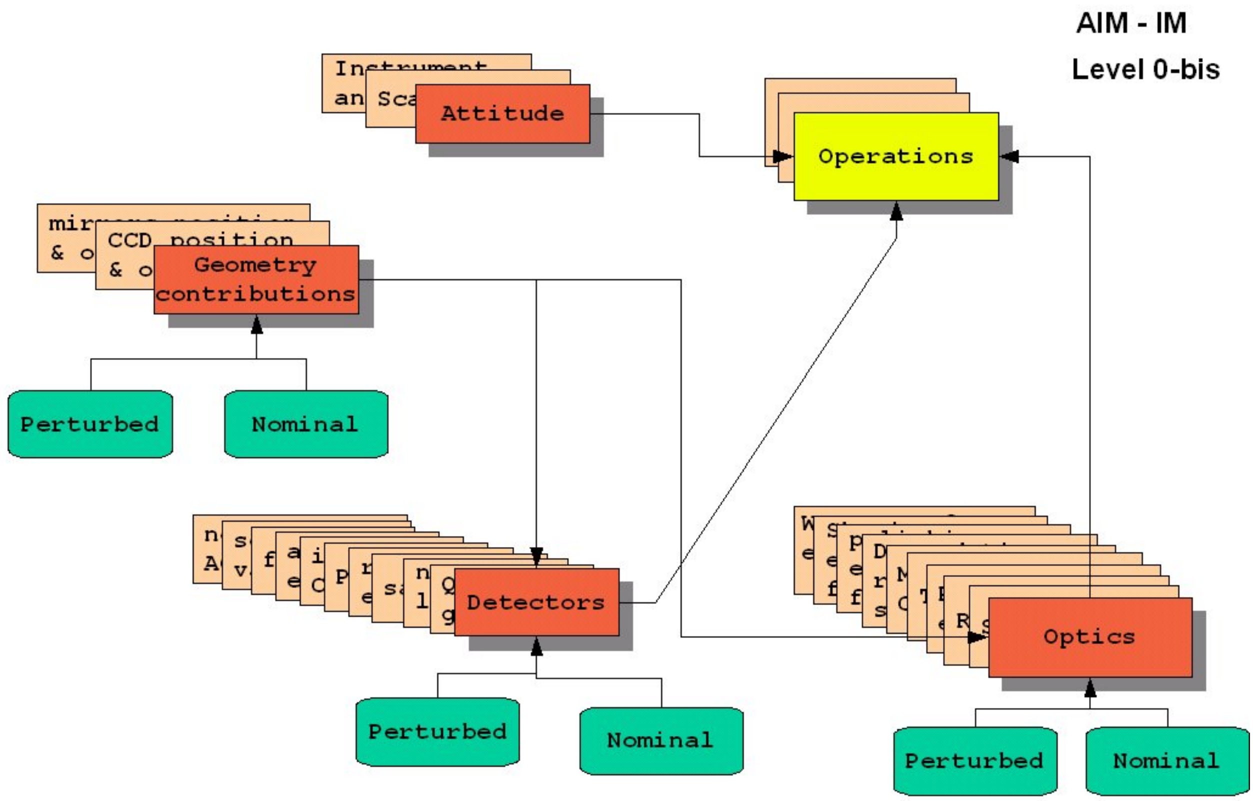
AIM-IM Level 0





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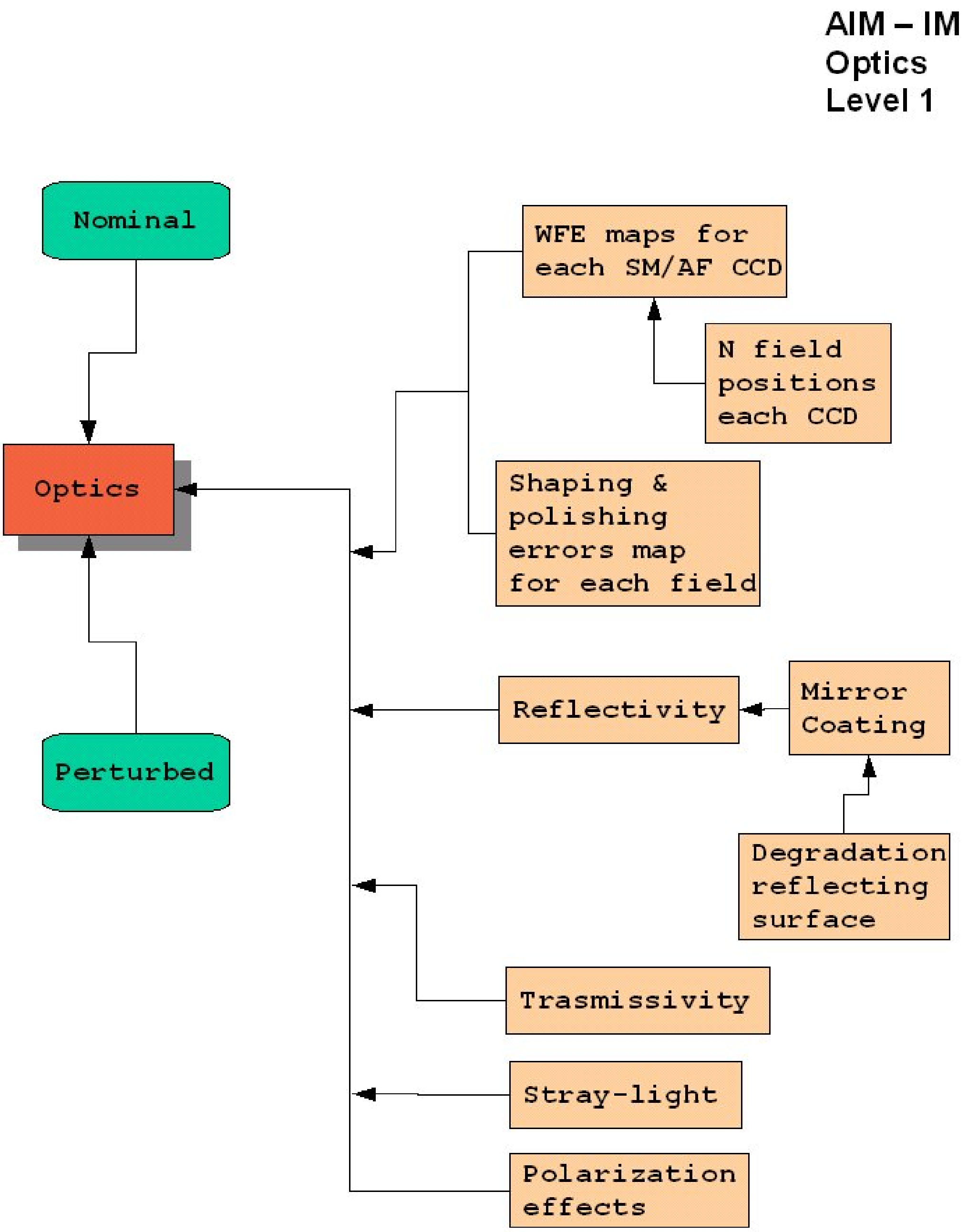
Optical package



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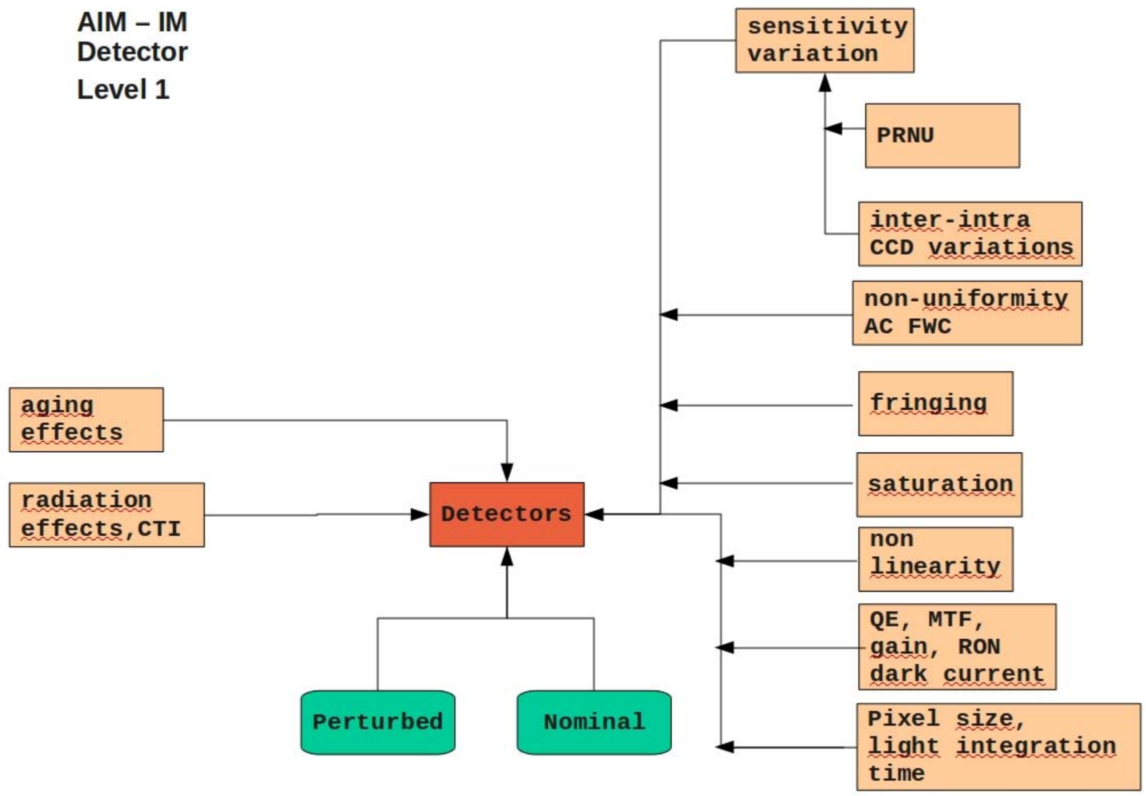
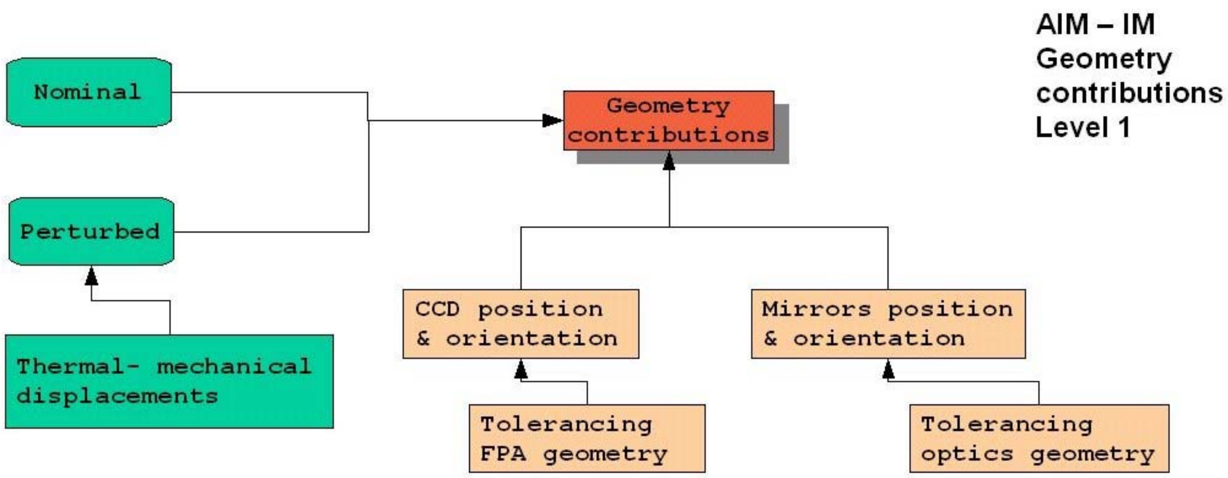
Detectors package



Geometry contributions



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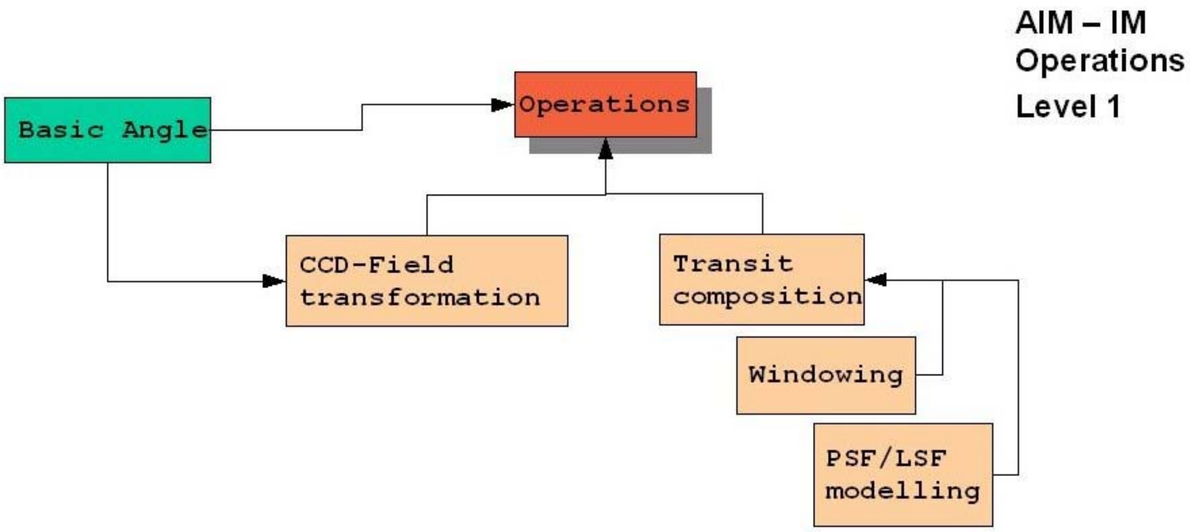
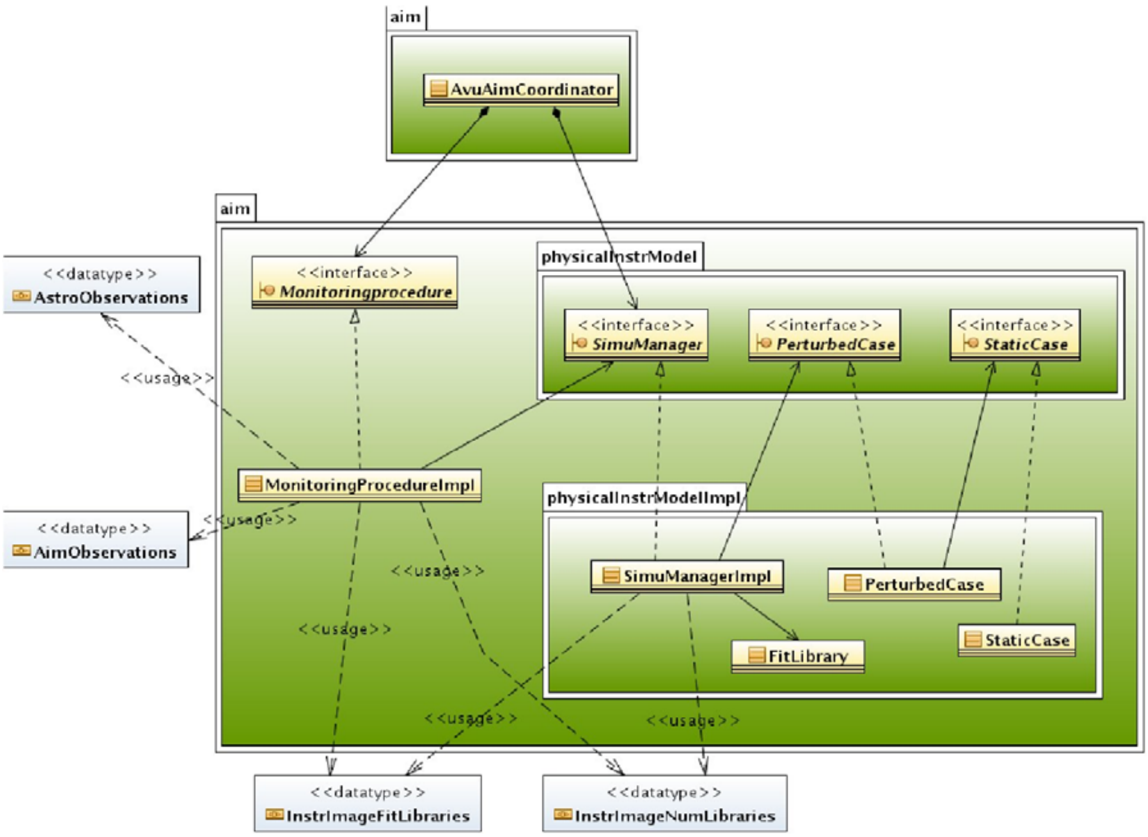
Operations package



The Physical instrument simulation package



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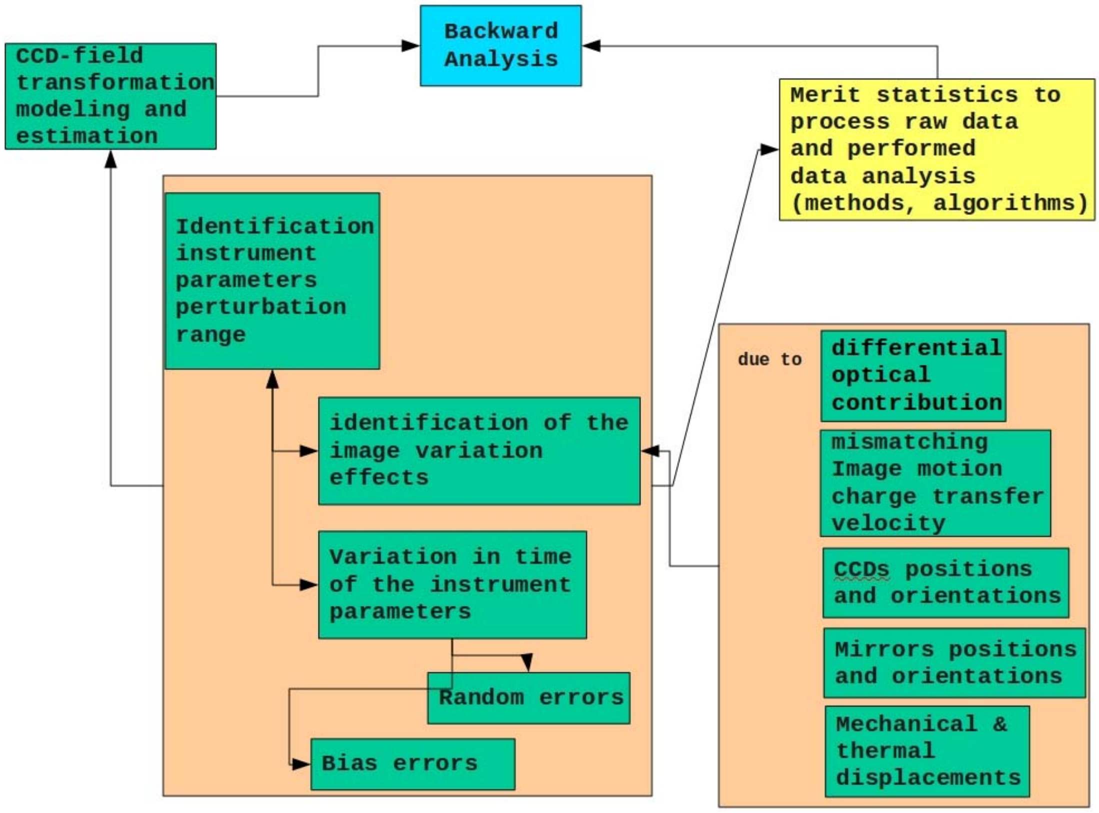
3.3 Backward analysis



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4 Milestones and delivarables

<table>
<tr><th>Milestones</th><th>Deliverables</th><th>Date</th></tr>
<tr><td>End cycle 9
first version of SW module PhysInstrMod preintegrated @DPCT
new RDProcessing with extended functionality preintegrated @DPCT
TN defining the set of global effective parameters
first version of SW module aimMonitoring preintegrated @DPCT (ready for CU level tests on DPT HW)
AIM V9 SW release for E2ES2 testing.</td><td>Technical Reports
Progress report
SW release</td><td>End Nov 2010</td></tr>
<tr><td>End cycle 10
RDProcessing with full 2D image fitting with extended functionality preintegrated @DPCT
new SW module PhysInstrMod with extended functionality preintegrated @DPCT
new SW module aimMonitoring with extended functionality preintegrated @DPCT
AIM V10 SW release for E2ES3 testing.</td><td>Technical Reports
Progress report
SW release</td><td>End May 2011</td></tr>
<tr><td>End cycle 11
new RDProcessing with extended functionality preintegrated @DPCT
new SW module PhysInstrMod with extended functionality preintegrated @DPCT
new SW module aimMonitoring with extended functionality preintegrated @DPCT
first version of SW module aimDiagnosticAnalysis preintegrated @DPCT
AIM V11 SW release for E2ES4 testing.</td><td>Technical Reports
Progress report
SW release</td><td>End Nov 2011</td></tr>
<tr><td>End cycle 12
TBD</td><td>Technical Reports
Progress report
SW release</td><td>End May 2012</td></tr>
<tr><td>End cycle 13
AIM ready for commissioning @DPCT
…..........</td><td></td><td>End Nov 2012</td></tr>
</table>

4.1 Detailed plans for Cycle 9

In the following table we show the detailed plan for cycle 9 with all the tasks needed to produce the AIM RDProcessing and the PhysInstrMod module and the personnel involved for the time being.

Task	old/new	cycle	comment	providers	start date	days
RDProcessing SW module, extended functionality						**75**
1 - study of the radiation treatment and possible implementation for AIM	old		90% done			20
2 - implementation of the general approach for the treatment of the radiation damage as defined in cycle 8	new	9		RUSSO, CORCIONE		10
3 - study of psf model and treatment for AIM	old	9		BONINO, BUSONERO,GAI		15
3a - extention of Gaia PSF model (gai-009) to the "Gaia"polychromatic approach	old	9		BONINO, BUSONERO,GAI		35
3b - extention of 3a) PSF model to full 2D windows	old	10		BONINO		
4 – Customization of the image parameters extraction module	new	9		RUSSO, BONINO		5
5 - fit of the polychromatic psf library with the new psf model	old	9		BONINO,BUSONERO		5
6 – implementation of the AIM psf model(11 param + derivs) 1D in java	old	9		BONINO,RUSSO		5
6a - implementation of the AIM psf model(11 param + derivs) 2D in java	new	10		BONINO, RUSSO		
7 – implementation of the new coefficients psf library	old	9		RUSSO,BUSONERO		3
4bis - investigation about the possible improvement on the image analytical model based on the b)-14 results	new	10				
8 - implementation of the revised structure of RDProcessing	old	9		RUSSO,BUSONERO		14
9 - pre-integration of RDProcessing into AIM @ DPCT and junit testing	old	9		RUSSO,BUSONERO		12
produce new version of RDProcessing	old	9				
PhysInstrMod SW module						**81**
10 – Identify the significant degrees-of-freedom for the astrometric field, their variation and resolution	old	9	70% done	LOREGGIA, RIVA, BUSONERO		35
11a – A few non-nominal configuration WFE maps	old	9				
11 - generation of non-nominal numerical optical configurations library for the identified values set (WFE maps) for n-points on each ccd	new	9		LOREGGIA, RIVA		10
12 - implement the CCD effects (opto-electronic characteristic and radiation damage) in the library to generate the 2D images library for the significant degrees of freedom	new			CORCIONE ?	?	
13 – simulation of non-nominal numerical optical and effective PSFs library	new			BUSONERO		70
14 – development and implementation of the AF image simulator including the GaiaSimu classes	new			RUSSO, BUSONERO, CORCIONE		20
15- simulation of polychromatic images for nominal and non-nominal configurations				BUSONERO, RUSSO	?	
16 - study of the images behavior over the all astrometric field depending on the physical parameters identified during 10 and 12.	new			BUSONERO, LOREGGIA, RIVA		25
17 - generate PSF coefficients library	old			BONINO, BUSONERO	?	
18 - development and implementation of PhysInstrMod infrastructure	old			RUSSO, BUSONERO		15
19 - first version of the SW module PhysInstrMod pre-integrated into AIM @ DPCT and junit testing	old			RUSSO, BUSONERO		11

Task	old/new	cycle	comment	providers	start date	days
aimMonitoring SW module						**60**
Template for AIM Daily Reports (define content)	old	9		BUSONERO		10
define and develop basic scientific algorthyms for aimMonitoring	old	9				
18 - define and implement aimMonitoring overall structure in Java	new	9		BUSONERO, RUSSO		15
19 - define and develop basic scientific algorithms for aimMonitoring pipeline (dependence on 14) (no java)	new	10		BUSONERO, GAI, BONINO		30
20 - implementation of basic algorithms in Java	old	9		RUSSO, BONINO		10
21 - first version of SW module aimMonitoring pre-integrated into AIM @ DPCT and junit testing	old	9		RUSSO, BUSONERO		11
Management						**47**
29 - Define AIM data-model for cycle 9		9		BUSONERO		3
30 - Define new requirements if any update SRS		9		BUSONERO		4
32 – Update SDD		9		BUSONERO, RUSSO		10
32 - Define new test procedures and update STS		9		BUSONERO, LATTANZI, RUSSO		15
34 - Produce AIM 9 STR		9		BUSONERO, RUSSO		10
35 - Produce AIM 9 SRN		9		RUSSO, BUSONERO		5
System Testing						**28**
35- Perform tests of AIM RDProcessing - local		9		RUSSO, BUSONERO		7
36- Perform tests of PhysInstrMod module – local		9		RUSSO, BUSONERO		5
37- Perform tests of AimMonitoring module – local		9		RUSSO, BUSONERO		7
40- Perform tests of AIM RDProcessing module @ DPCT		9		RUSSO, BUSONERO		2
41- Perform tests of PhysInstrMod module @ DPCT		9		RUSSO, BUSONERO		2
42- Perform tests of AimMonitoring module @ DPCT		9		RUSSO, BUSONERO		2
44- Verify Altec test outputs against local results		9				3
AIM system tests @ DPCT	old	9				

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4.2 Schedule diagram

The following schedule diagram for cycle 9 was prepared in collaboration with the Project Manager of the Italian participation to the DPAC.