Monitoring of Muon Alignment in ATLAS spectrometer deployed inside a J2EE server

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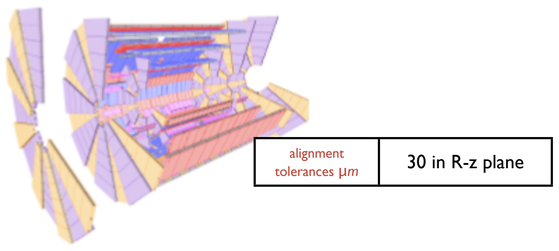


Muon Spectrometer Alignment

Based on optical sensors and muons tracks for overlapping regions (Barrel/Endcap) and for relative alignment among Muon spectrometer and Inner Detector (ID)

3 sub systems: Barrel and 2 Endcaps

1200 MDT chambers described by 6 positional parameters (~7000 DoF) and 11 deformation parameters (21000 DoF in total)

Muon Alignment algorithms
Compute minimization for position and deformation parameters for Barrel and Endcap systems

Barrel (ASAP)
C++ program based on ROOT
Ad hoc minimization algorithm

Endcap (ARAMYS)
C program based on MINUIT

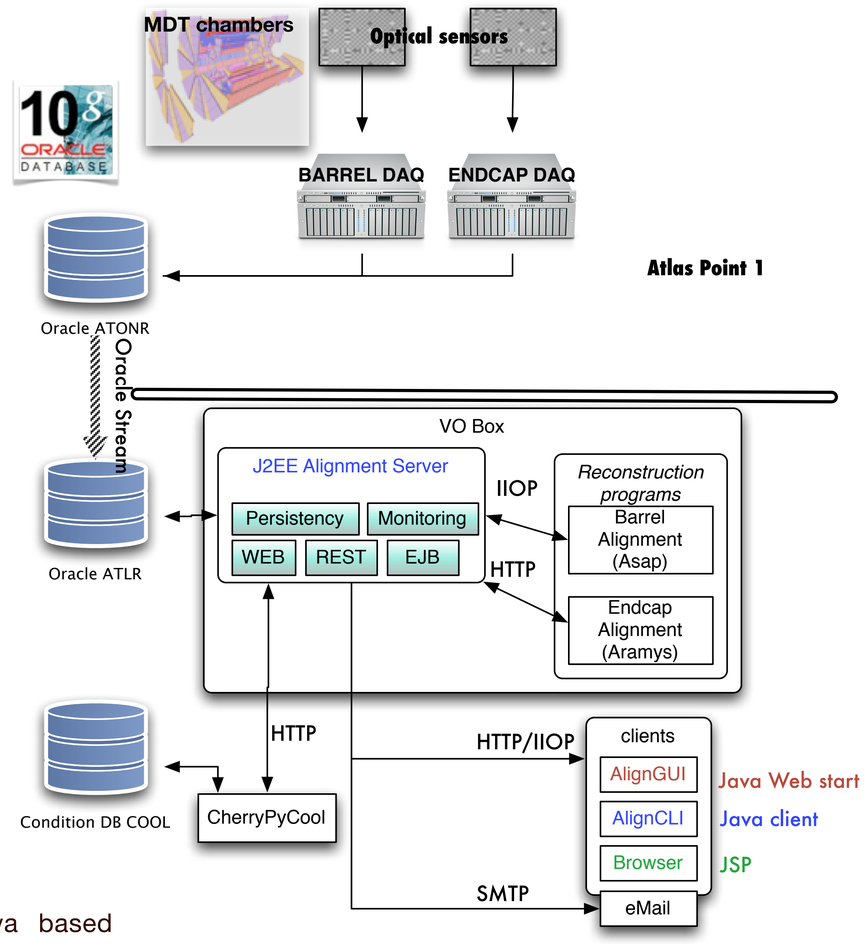
Alignment Data Flow

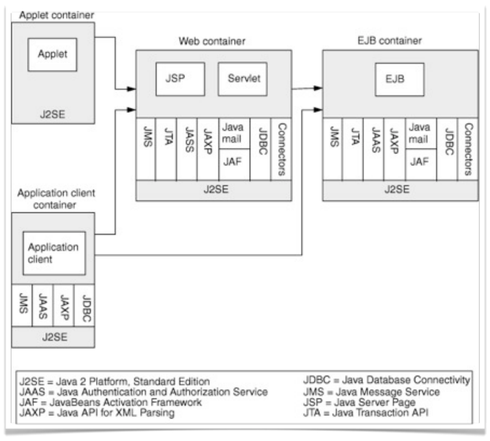
Online : Barrel and Endcap DAQ systems analyze the optical sensors response every ~10 minutes and write into a set of Oracle tables their result (online Oracle server ATONR).
Offline : The table content is migrated to offline Oracle server (ATLR). This database contains also the output of alignment algorithms, which compute chamber positions and deformations from the optical sensor measurements.

- IO with DB server performed via a J2EE application deployed in JBoss AS.
- Java server controls Barrel alignment algorithm via CORBA.
- Endcap alignment algorithm uses the J2EE server to gather optical lines measurements and to store output corrections for the Endcap wheels.

COOL Condition DB
The chamber corrections are used at the level of muon reconstruction program (Athena framework). Muon reconstruction program checks the presence of Conditions data in a specific DB called COOL, always inside Oracle servers.

- Condition data migration to COOL is performed for Muon alignment via an ad hoc CherryPy server, using HTTP methods
- The data volume of muon alignment corrections is about 2 GBy per year for the whole spectrometer





J2EE Monitoring

Java libraries for DB access, handling all alignment inputs and outputs, configuration data for ASAP program, bookkeeping of Conditions Data information

JBoss
JBoss AS, which delivers full J2EE specifications: EJB and WEB container, JMS, security via JAAS API...

Packaging
Several libraries for Muon Alignment monitoring are developed and packaged inside an Enterprise ARchive

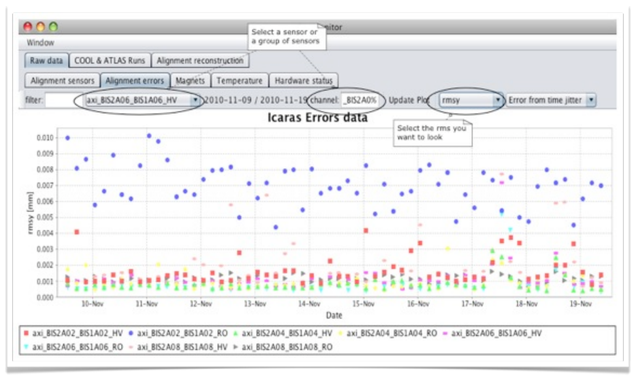
J2EE Monitoring Tasks

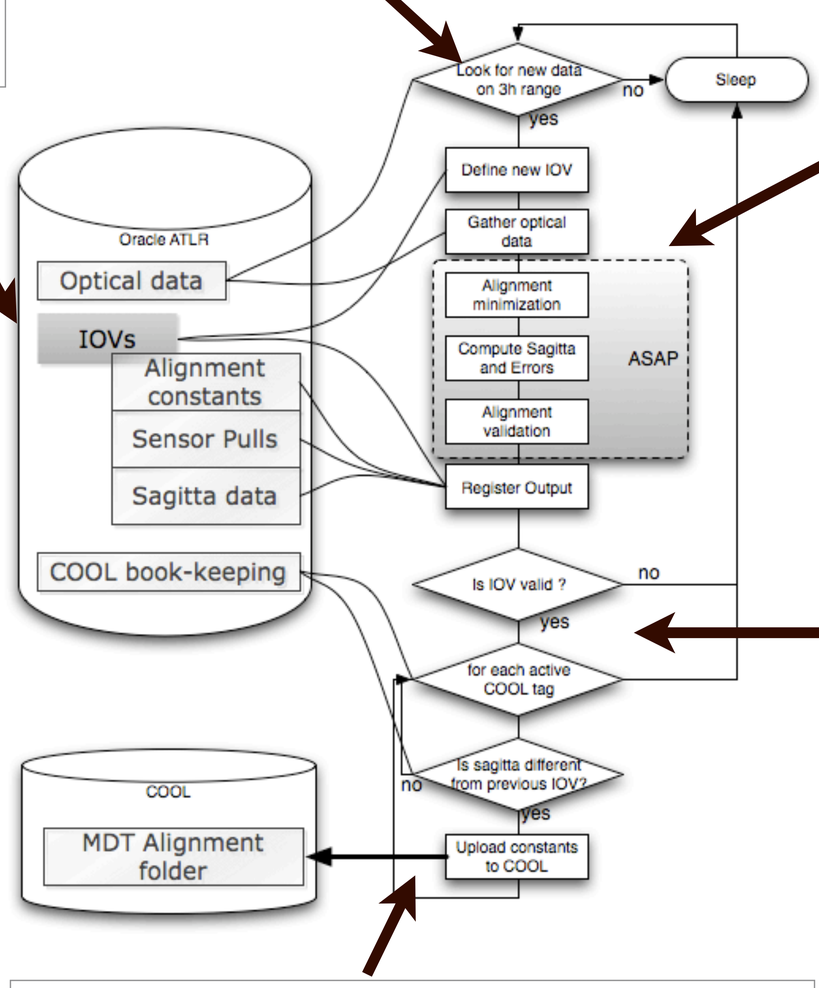
The monitoring functionalities delivered by the Java based application inside the server are implemented as scheduled tasks and client access interfaces

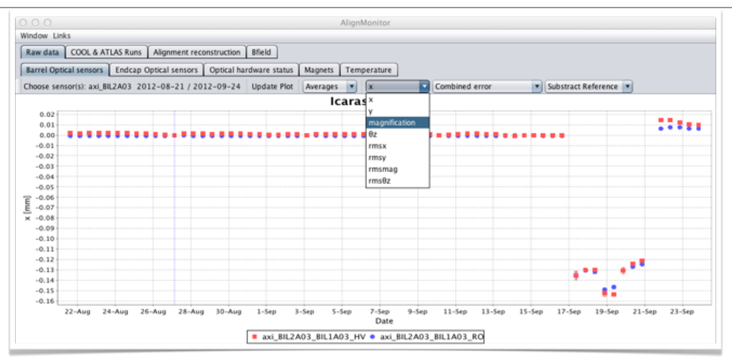
IntervalMaker
Checks if new intervals are available: in general 3h of data should be available, with stable mag field conditions.

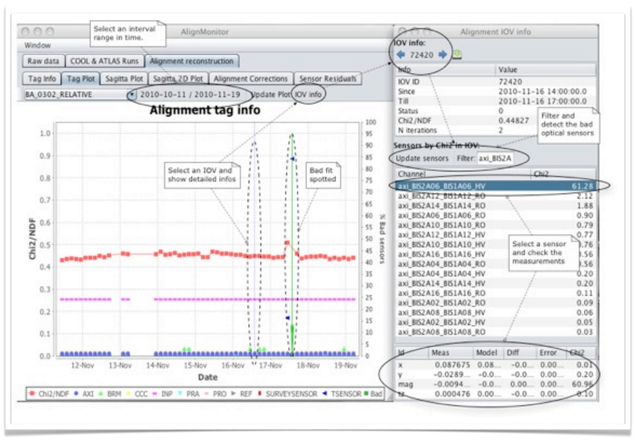
Optical sensor errors scheduler
Compute errors on sensor's images measurements, via a linear fit which is implemented as an Oracle query (usage of ...).

Reconstruction Scheduler
Gather optical sensor data over the interval defined by IntervalMaker and launch ASAP reconstruction algorithm via CORBA. Creates ROOT Tree for the input and read ROOT output tree produced by ASAP.

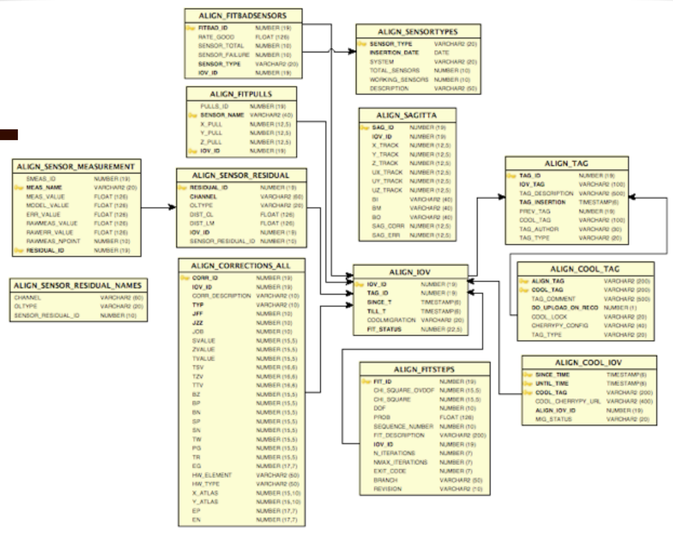








Chi2
Stability of the fit can be checked by plotting chi2 VS time



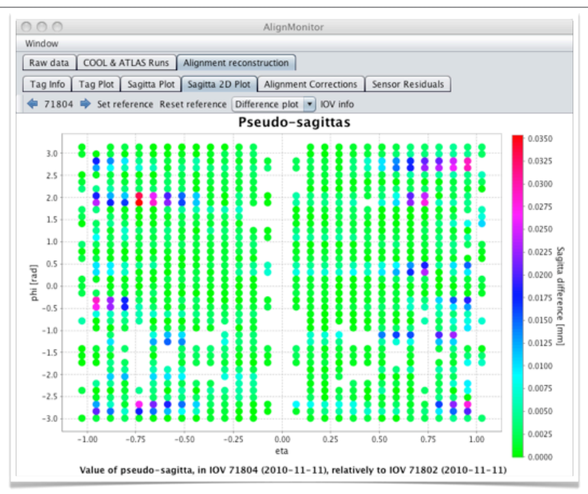
Cool uploader Scheduler
Check the stability of every valid alignment interval respect to the previous interval stored in COOL Condition DB (Atlas). The stability is monitored by using sagitta data.

AlignGUI
Client program interacting with the J2EE application via RMI over HTTP. It allows to follow the alignment fit stability, collect informations on single interval corrections at the level of single sensors, and visualize input and output data in order to provide experts a feedback on the system. It has also browsing functionalities for the COOL Conditions DB.

J2EE Client Applications

Several libraries for interacting with the monitoring server

- **WEB interface** : a JSP based application to follow the optical line status
- **WEB RESTful services** : a set of REST services to gather monitoring information. The urls are then rendered via xsl.
- **AlignGUI** : Java Web Start application (Java Swing) which interacts with the full alignment DB to show every needed information to monitor the system.
- **AlignCLI** : command line client, mainly for administration tasks.



Sagitta
The sagitta of generated straight tracks is stored in DB using a given set of corrections parameters. This allow experts to compare changes in an eta/phi plane for the whole muon spectrometer, and visualize the towers of chambers for which a big difference has been detected respect to a previous interval.