Detector-detector dependencies in alignment

Raffaele Grosso

CERN

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Introduction

Dependencies between alignment of neighbour detectors concern all detectors: if correctly reproduced in the geometry, these dependences should not introduce overlaps.

Starting to deal with survey data and improving the simulation of real misalignment some special alignment dependencies between detectors (or detectors and structures) are brought into play.
Survey-to-alignment, geometry and in specific cases also global run parameters can be concerned.
What is the better way to deal with these dependencies?

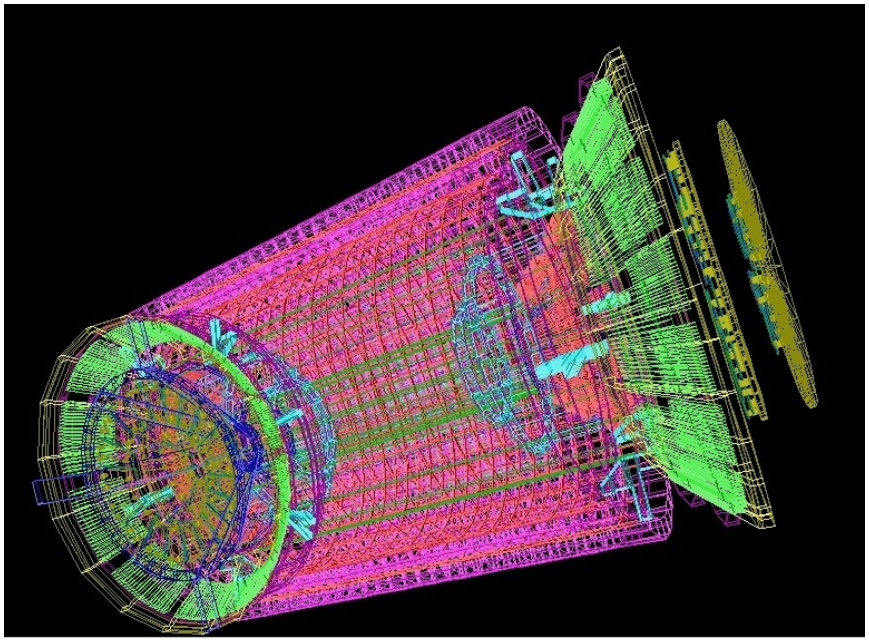
Three general cases

Up to now the following cases have emerged:

1. The first detector does not have its own survey; being integral with a second detector, the first detector needs to fully derive its survey from the second one. Example:
   - FMD2 and FMD3 fully depend on survey of ITS
   - V0A is integral with FMD1
   - probably several other similar cases
2. One of the two detectors is a structure (a non-sensitive module). For example several detectors placed around the beam-pipe are integral with it. A global run parameter can be concerned. Example: the beam-pipe is attached to ITS support cones: this affects also the interaction point (IP).
3. A detector can/needs to integrate its survey data with those of a supporting structure: Example:
   - TRD and TOF supermodules, surveyed only on the A side, hanging on the well monitored space-frame

Case 1: full dependency in survey

Det-A fully depends on survey of det-B.



Example: FMD2 and FMD3 are attached to ITS. Volumes involved:

- **ALIC_1/F2MT_2** and **ALIC_1/F2MB_2** should move together with **ALIC_1/ITSV_1/ITSD_1** on the A-side
- **ALIC_1/F3MT_3** and **ALIC_1/F3MB_3** should move together with **ALIC_1/ITSV_1/ITSD_1** on the C-side

Case 1: full dependency in survey

Two possible solutions

1. in the geometry, make the two volumes part of a single `TGeoAssembly`;
2. single alignment from survey including the two detectors. This means:

   one single survey-to-alignment macro
   one single `MakeDETFullMisAlignment` macro

   for the two detectors.

Case 1: full dependency in survey

Both solutions allow:

- to apply the survey data for detB to both detA and detB coherently and in a synchronised way;
- to allow later independent realignment of each detector.

The choice is probably a matter of taste, nevertheless it would be good to have a choice common for the whole ALICE geometry. In my view the second solution (common macro) is to be preferred because:

- the dependency is softer;
- detector level is in general the right level to keep things independent in the hardcoded geometry.

ITS - beam-pipe and interaction point

The positions of the whole ITS, of the central part of the beam-pipe and of the interaction point are interdependent:

- The theoretical interaction point is fixed w.r.t. a grid of reference points in the cavern once the low-beta quads are put in their final position. On this basis it could be chosen as the origin of the ALICE RS.
- It is foreseen that the ITS + central part of the beam-pipe will not be steadily centered at the theoretical interaction point (and origin of ALICE RS). Expected displacement $/sim$mm in the transverse plane.
- The beams will be fine-tuned so that the interaction point is still in the center of its+pipe

$\Rightarrow$ the interaction point will not correspond to the theoretical interaction point.

ITS - beam-pipe and interaction point

To simulate the misalignment of the whole ITS we have to:

- modify the position of ITS and pipe in the geometry
- have in simulation the interaction point displaced from (x,y) = (0,0) to the center of the misaligned ITS and beam-pipe.

A possible solution:

have the IP position in the GRP read both by the config-file and by the `MakeITSFullMisAlignment`.

Space-frame and TOF-TRD

Being the TOF and TRD supermodules very long (m) and heavy (0.7 tons for TOF), they can take considerable advantage in using the information from the space-frame monitoring system (SMS). The inclusion of SMS information to TOF and TRD alignment leads to some important open issues:

- where will SMS data be written, in which format
- how will SMS data be converted to alignment objects
- how will TRD and TOF take advantage of it

Needed progress

A complete list of alignment dependencies needs to arise from people in charge of each detector's survey/geometry/alignment.
After that the appropriate measure can be agreed between the concerned detectors.