Development and application of CATIA-GDML geometry builder

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Design optimization of complex, densely packed systems in severe radiation conditions (like FAIR experiments) requires iterative exchange of geometry and material information. For mechanical, thermal, and some of electromagnetic software the transfer is automated. For radiation simulation packages it is not the case.

We are presenting an update on the development and application of a tool for manual building of an optimized simulation geometry based on a CAD model. Earlier version of the tool was presented at CHEP2010 [1].

Examples

The method

1. Mapping the G4-ROOT like geometry into CATIA product tree
a) Solid (TGeoShape):
- Implementation of primitives as parameterized User Defined Features (UDF) in CATIA. The UDFs are placed into G4Catalog. The following primitives are realized: G4Box; G4Cone; G4Cylinder; G4EllipticalCone; G4EllipticalTubs; G4Torus; G4Trap; G4Tid; G4Tubs; G4TwistedBox; G4TwistedTrap; G4TwistedTid; G4TwistedTubs. Pilot versions of G4Polycone and G4Polyhedra are also available.
- Realization of Boolean combinations using CATIA operators AND, OR, and XOR.
b) Logical/Volumes (TGeoVolume)
- File structure is realized in a template.
- Name of the material is introduced as a parameter.
- PartBody contains a parameterized (CAD) solid.
- Unparameterized copy of the PartBody is published.
c) Physical/Volumes (TGeoNode)
- Solids, published in files corresponding to a smaller Logical/Volumes (TGeoVolume) can be inserted into the tree with positioning. They represent daughter volumes.
- Linear and circular G4PVReplica (TGeoVolume "Dived") are implemented for multiple instantiation.
- G4Assembly/Volumes (TGeo/Volume/Assembly) are marked by material-assemblies and are able to manifest representations of daughters at the upper level

2. Developing the VBA tools facilitating creation of the G4-ROOT like geometry
Inserter:
- places a daughter volume inside the mother one and creates a template for rotations and translations;
- A dedicated checkbox allows to transform the mother volume into assembly.
Array maker:
- creates a circular or linear array of individual placements of daughters of "grandfather" volumes or generates G4PVReplica (TGeoVolume "Divide")
PnP: Allows to translate a Boolean operand or a daughter volume by clicking initial and final points.
Measure:
- allows to measure length, radius of an object or a distance (angle) between two objects, and gets them into any parameter of a G4-ROOT like model
Move:
- Allows to translate simultaneously a set of volumes
Symmetry: Creates Physical-volumes-symmetric to selected set w/ a given plane. When necessary a serial number of an existing volume is generated. So far works only with primitives.
PickPoint Trap: Calculates and puts into the tree the values of parameters, translations and rotations for a Trapoid defined by picking with a mouse & mousepad.
Checker:
- Allows to check the correctness of G4-ROOT compatible tree and overlaps of volumes
Material reassigner:
- Allows to assign all the materials from the upper level of the CATIA product.
GDML Parameterization:
- For exchange of the G4-ROOT compatible geometry between CATIA and GDML packages GDML [4] is used. GDML variables are implemented using CATIA parameters and relations.
CATIA2GDML: It is a converter from the G4-ROOT compatible CATIA tree to the GDML accessible readable by ROOT and GEANT4.
GDML2CATIA: It is a converter from GDML to CATIA. It allows to bring any simulation geometry into CATIA

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