The Virtual Geometry Model

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VGM

- The Virtual Geometry Model (VGM) is a geometry conversion tool.
- It currently provides conversion between Geant4 and ROOT TGeo geometry models.
- Its design allows inclusion of another geometry model by implementing a single sub-module instead of writing bilateral converters for all already supported models.
- Last presented at CHEP in 2008, since then under a continuous maintenance and development, following the evolutions of the supported geometry models and adapting to different use cases.
- Integrated in Geant4 VMC for the support of external geometry definition (TGeo with Geant4, Geant4 with Geant3).
- Distributed in GitHub vmc-project organization (since 2017)
  - See also the CHEP19 contribution #322

Components

- Interfaces (VGM)
  - Abstract interfaces to geometry entities used for geometry description (solid, volume, placement, material) and the factories for creating geometries and their import/export
- Utilities (BaseVGM, ClhepVGM)
  - Common implementation and utility functions
- Geometry modules (Geant4GM, RootGM)
  - Implementation of the VGM interfaces for concrete geometry models
- XML Exporter (XmlVGM)
  - Exporters to GDML and AGDD XML formats
- Examples
  - Four examples demonstrating geometry conversion (EQ1,EQ2) and export in XML (EQ3, EQ4)
- Test
  - Test application covering most of supported use cases
  - Command line options to select the input/output geometry type, test case (Solids, Placements, ...), run mode (Geant4 /G4Root navigation, single solid mode) and other options (debug, ignore, bestMatch)
  - Test suite scripts with reference outputs

Supported Features

- In general: the intersection of supported features in ROOT and Geant4 geometries
  - Plus some features with work-arounds in the other geometry model
- Solids – see on the right
  - And also scaled and displaced solids
- Placements:
  - Simple placements with rotation and reflection
  - Multiple placements: divisions, replicas, assemblies, replicated slices (divisions with gaps)

Use Cases

- Geometry bi-lateral conversion between the supported geometry models (Geant4, ROOT TGeo)
  - Fast, In memory conversion
  - See the code sample on the right
- Geometry verification
  - Comparing the outputs with Geant4 native and G4Root navigation in source and target geometries
- Export geometries in GDML, AGDD
- Single solid mode conversion

Infrastructure

- CMake build system
  - The old build systems (GNUmakefile based, Autoconf, CMT) were removed
- GitHub deployment
  - Moved from SourceForge
- Doxygen
  - For source code documentation
- Clang-format
  - For source code formatting

Examples of test cases:

1. import Geant4 geometry to VGM
2. Export VGM geometry to Root
3. Write converted geometry to ROOT file

Test suite scripts with reference outputs

// Import Geant4 geometry to VGM
Geant4GM::IFactory g4Factory;
g4Factory.Import(geant4PV);

// Export VGM geometry to Root
RootGM::IFactory rtFactory;
gr4Factory.Export(rtFactory);
g4GeoManager->CloseGeometry();

// Write converted geometry to ROOT file
gGeoManager->Export("geometry_root");