

Extended example - using VecGeom Navigation in Geant4

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New extended example

Release 11.0-beta the new [extended/geometry/vecGeomNavigation](#) example:

- Demonstrate *prototype interface of vecGeomNavigation* in Geant4
- *Converts* the geometry to create the equivalent VecGeom setup
- Configuration: navigate in 'pure' Geant4 or 'mixed' G4/VecGeom mode

Uses the [VecGeom/G4VecGeomNavigation](#) repository for interface code

- Intended to become part of G4 once finalised

Key elements

G4VecGeomNavigation library

- G4VecGeomConverter: convert G4 geometry and create VecGeom in memory
- TG4VoxelVecGeomNavigation: replacement for G4VoxelNavigation
- VecGeomG4Solid: wrapper for G4VSolid (for solid types not yet converted.)

The example [extended/geometry/vecGeomNavigation](#)

- Detector Description: first read GDML file, then convert
- Converts the geometry to equivalent VecGeom setup - only logical volumes with placement daughters are affected.
- Navigates in either both setups depending on configuration
 - In 'comparison' mode it reports differences verbosely

Status

The VecGeom-navigation integration is in development.

The example can either:

- execute a batch file (option -m)
- run interactive commands, (option -i), or
- run both batch (first) and interactive.

The example loads a GDML file for the geometry. We tested with

- Simple (TestEm3 converted to placements)
- NTST (BaBar inner detector)
- CMS 2015 and 2018 (take many hours to created optimised safety voxels)

Why use VecGeom Navigation in Geant4 ?

VecGeom Navigation offers a number of new features vis-a-vis G4(Voxel) navigation:

- Custom/separate types of navigation (compute step) via VNavigator interface
 - which can be customised / selected for each volume at runtime
- BVH-based 'HybridNavigator' which (can) use VecCore-accelerated operations to eliminate multiple candidate volumes via their (axis-aligned) bounding boxes.
- Custom safety calculation - selectable on per (mother logical) volume (at runtime)
 - Plus innovative method to calculate safety - using pre-computed lists of candidate volumes in the 'subtraction' volume of mother minus all daughters (beta - can require substantial computation for mother volumes with many daughters)
- Potential speedup of 10% seen in benchmarks of first version (2019)
- Ability to exploit features of VecGeom not available in current G4Solids 'bridge': shape specialisations, placed solids

Dependencies

Two projects are required directly: VecGeom and G4VecGeomNav.

VecCore is also required, configured and found through VecGeom.

Option: use Root in G4VecGeomNav to store (safety) voxel information

- Recommended if using new safety computation method
- which requires significant computation to calculate for logical volumes that contains many daughter volumes - or very complex ones.

It can be tricky to configure the stack of libraries - link errors in some configurations

'Feedback'

Please try it out. Feedback welcome:

- reports of success or problem with other geometries
- problems with fixes are super welcome !!

END

Backup Slides

Dependencies (part 2)

It imports a selected version of the [VecGeom/G4VecGeomNavigation](#) repository, compiles and links it

- thanks to Ben Morgan for rewriting this capability.
- Uses the [VecGeom/G4VecGeomNavigation](#) repository for interface code
- Intended to become part of G4 - probably in time for release 11.0

Configuration

- To configure you must set:

```
setenv CMAKE_PREFIX_PATH "${VECCORE_DIR}:${VECGEOM_DIR}"
```

or if using Root (either to use Vc from it or to store voxels)

```
setenv CMAKE_PREFIX_PATH "${ROOTSYS}:${VECGEOM_DIR}"
```

Note: If using Vc (for VecCore) VecGeom must be built with only one installation of Vc (whether from Root or elsewhere.)

G4VecGeomConverter

This class converts a Geant4 geometry in memory to a VecGeom Geometry

G4Placement	VPlacedVolume
G4LogicalVolume	LogicalVolume
G4VSolid	VUnplacedSolid

Converts most G4VSolids, including Box, Trap, ... Polycone.

Does NOT handle Replica / ParameterisedVolume / Division etc

Test cases

New test cases:

- 'NTST' geometry (D. Williams, UCSF) Inner Detector of Babar (ca 2001)
- FullCMS - imported from cms2015.gdml or cms2018.gdml
- ATLAS - gdml files from FullSimLight (Marilena Bandieramonte)

Current results:

- NTST: runs reliably in either mode
- FullCMS: reports differences in 'comparison' mode; fails standalone
- ATLAS: under testing ...