



# Progress Update on SolidWorks -> Geant4 Converter

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# Translator Program

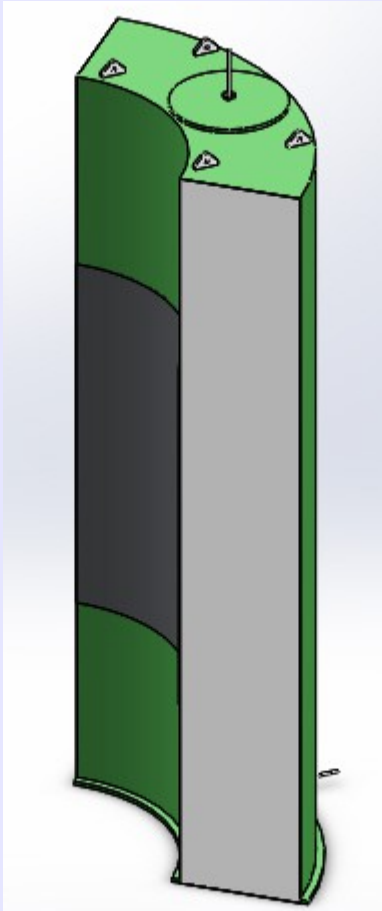
- C++ program developed with Visual Studio and using the SolidWorks API
- About 3000 lines of code currently
- Takes one SolidWorks file and produces GDML output file



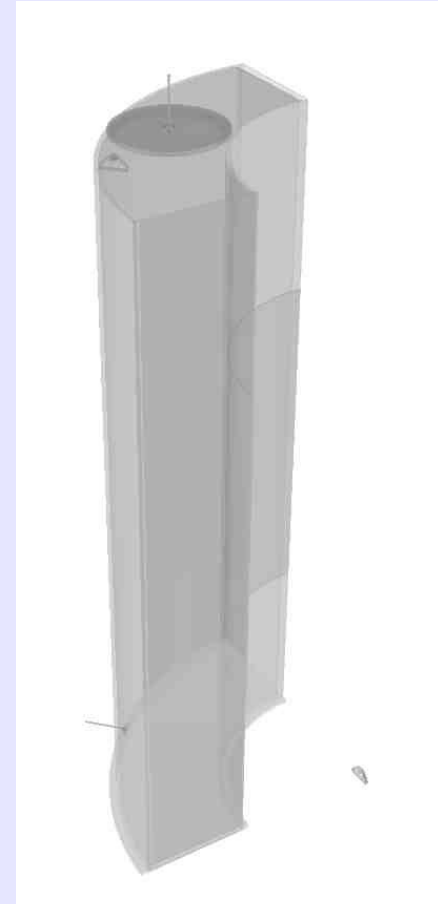
# Processing Entire SW Assemblies



SolidWorks Design



Same Design in Geant4



- Many separate components, each with its own coordinate system
- Every part in place except for three lifting eyes at origin



# Diversion: Problem of Mates

- Mates provide displacement and rotation between coordinate systems
- SolidWorks supplies confusing and redundant information about mates
- Have reverse-engineered several solutions, but solutions may be brittle
  - New SolidWorks file might handle mates in yet another fashion



# Complex Mates -- Displacement

How to choose correct displacement in every case?



```
num mates 2
Alignment = aligned
MateEntity2 count = 2
Mate Reference type 2
MateEntity location = (-1e-006, 0.0762, 1e-006)
MateEntity direction = (0.707107, -0, -0.707107)
MateEntity radii 1 and 2 = 0.00635 0
comp name LS-side-tank-1_edin-1
Mate Reference type 2
MateEntity location = (1.22131, 0.0762, -1.22131)
MateEntity direction = (0.707107, 0, -0.707107)
MateEntity radii 1 and 2 = 0.00635 0
comp name tube-fitting_edin-2/fitting-stub_edin-1
Alignment = anti-aligned
MateEntity2 count = 2
Mate Reference type 2
MateEntity location = (0, 4.74218, 0)
MateEntity direction = (-0, -1, -0)
MateEntity radii 1 and 2 = 1.7272 0
comp name LS-side-tank-1_edin-1
Found mate entity
Mate Reference type 2
MateEntity location = (1.22131, 0.0762, -1.22131)
MateEntity direction = (-0.707107, 0, 0.707107)
MateEntity radii 1 and 2 = 0 0
comp name tube-fitting_edin-2/fitting-stub_edin-1
Final displacement = (2.44263, -4.51358, -2.44898)
aatot = (1.22131, -4.66598, -1.22131)
```

For tube-fitting\_edin-2  
correct displacement is:  
(1.22131, 0.0762, -1.22131)

```
num mates 3
Alignment = anti-aligned
Type = coincident
Mate Reference type 2
MateEntity location = (1.7272, 4.74218, 0)
MateEntity direction = (0, -0, 1)
MateEntity radii 1 and 2 = 0 0
comp name LS-side-tank-1_edin-1
Mate Reference type 2
MateEntity location = (0.9779, 0, 0)
MateEntity direction = (-0, 0, -1)
MateEntity radii 1 and 2 = 0 0
comp name tyvek-side-tank_edin-1
Alignment = aligned
Type = coincident
Mate Reference type 2
MateEntity location = (0, 4.74218, 0)
MateEntity direction = (0, 1, 0)
MateEntity radii 1 and 2 = 0 0
comp name LS-side-tank-1_edin-1
Mate Reference type 2
MateEntity location = (1.7272, 4.74218, 0.000254)
MateEntity direction = (-0, 1, -0)
MateEntity radii 1 and 2 = 0 0
comp name tyvek-side-tank_edin-1
Alignment = anti-aligned
Type = coincident
Mate Reference type 1
MateEntity location = (1.7272, 4.74218, 0)
MateEntity direction = (0, -1, 0)
MateEntity radii 1 and 2 = 0 0
comp name LS-side-tank-1_edin-1
Mate Reference type 1
MateEntity location = (1.7272, 0, 0)
MateEntity direction = (0, 1, 0)
MateEntity radii 1 and 2 = 0 0
comp name tyvek-side-tank_edin-1
Final displacement = (0.9779, 0, 0.000254)
aatot = (-0.7493, -9.48436, 0)
```

For tyvek-side-tank\_edin-1  
correct displacement is:  
(0.9779, 0, 0)

```
num mates 3
Alignment = anti-aligned
Type = coincident
Mate Reference type 2
MateEntity location = (0, 4.74218, -0.9779)
MateEntity direction = (-1, 0, -0)
MateEntity radii 1 and 2 = 0 0
comp name LS-side-tank-1_edin-1
Mate Reference type 2
MateEntity location = (0, 0, -0.9779)
MateEntity direction = (1, 0, 0)
MateEntity radii 1 and 2 = 0 0
Overall rotation set to = (0, 1.5708, 0)
comp name tyvek-side-tank_edin-2
Alignment = aligned
Type = coincident
Mate Reference type 2
MateEntity location = (0, 4.74218, 0)
MateEntity direction = (0, 1, 0)
MateEntity radii 1 and 2 = 0 0
comp name LS-side-tank-1_edin-1
Mate Reference type 2
MateEntity location = (0, 4.74218, -1.7272)
MateEntity direction = (0, 1, 0)
MateEntity radii 1 and 2 = 0 0
comp name tyvek-side-tank_edin-2
Alignment = anti-aligned
Type = coincident
Mate Reference type 1
MateEntity location = (0, 4.74218, -1.7272)
MateEntity direction = (0, -1, 0)
MateEntity radii 1 and 2 = 0 0
comp name LS-side-tank-1_edin-1
Mate Reference type 1
MateEntity location = (0, 0, -1.7272)
MateEntity direction = (0, 1, 0)
MateEntity radii 1 and 2 = 0 0
comp name tyvek-side-tank_edin-2
Final displacement = (0, 0, -1.7272) aatot = (0, -9.48436, 0)
```

For tyvek-side-tank\_edin-2  
correct displacement is:  
(0, 0, -1.7272)



# Solution to Displacement?

- If number of mates  $< 3$ , then use 2<sup>nd</sup> entry of last aligned mate for displacement
- Else
  - ›  $\text{displace} = A_1 - A_2 + A_3 - A_4 \dots + \text{Sum of } AA_i$
  - › where  $A_i$  is sum of two aligned entries
  - › and  $AA_i$  is 2<sup>nd</sup> anti-aligned entry - 1<sup>st</sup> entry



# Complex Mates -- Rotation

How to choose correct rotation in every case?

```
Alignment = aligned
Type = other
Mate Reference type 2
MateEntity location = (-1e-006, 0.0762, 1e-006)
MateEntity direction = (0.707107, -0, -0.707107)
MateEntity radii 1 and 2 = 0.00635 0
comp name LS-side-tank-1_edin-1
Mate Reference type 2
MateEntity location = (1.22131, 0.0762, -1.22131)
MateEntity direction = (0.707107, 0, -0.707107)
MateEntity radii 1 and 2 = 0.00635 0
comp name tube-fitting_edin-2/fitting-stub_edin-1
Alignment = anti-aligned
Type = other
Mate Reference type 2
MateEntity location = (0, 4.74218, 0)
MateEntity direction = (-0, -1, -0)
MateEntity radii 1 and 2 = 1.7272 0
comp name LS-side-tank-1_edin-1
Mate Reference type 2
MateEntity location = (1.22131, 0.0762, -1.22131)
MateEntity direction = (-0.707107, 0, 0.707107)
MateEntity radii 1 and 2 = 0 0
```

For tube-fitting\_edin-2  
correct rotation is:  
(0, -1, 0) to  
(-0.707107, 0, 0.707107)

```
num mates 3
Alignment = anti-aligned
Type = coincident
Mate Reference type 2
MateEntity location = (0, 4.74218, 0)
MateEntity direction = (0, 1, 0)
MateEntity radii 1 and 2 = 0 0
comp name LS-side-tank-1_edin-1
Mate Reference type 2
MateEntity location = (0.669029, 4.74218, -1.56705)
MateEntity direction = (0, -1, 0)
MateEntity radii 1 and 2 = 0 0
comp name lifting_eye_edin-1
Alignment = aligned
Type = other
Mate Reference type 4
MateEntity location = (0, 0, 0)
MateEntity direction = (0.707107, 0, 0.707107)
MateEntity radii 1 and 2 = 0 0
comp name LS-side-tank-1_edin
Mate Reference type 2
MateEntity location = (0.633108, 4.79298, -1.49521)
MateEntity direction = (0.707107, 0, 0.707107)
MateEntity radii 1 and 2 = 0 0
comp name lifting_eye_edin-1
Alignment = anti-aligned
Type = other
Mate Reference type 4
MateEntity location = (0.633108, 4.74218, -1.49521)
MateEntity direction = (-0.707107, 0, 0.707107)
MateEntity radii 1 and 2 = 0 0
New axis is = (0.707107, -0, -0.707107)
Overall rotation set to = (0, -0.785398, 0)
comp name lifting_eye_edin-1
Mate Reference type 4
MateEntity location = (0.956397, 0, -0.956397)
MateEntity direction = (0.707107, 0, -0.707107)
MateEntity radii 1 and 2 = 0 0
```

For LS-side-tank-1\_edin  
correct rotation is:  
(1, 0, 0) to  
(0.707107, 0, -0.707107)

```
num mates 3
Alignment = closest
Type = coincident
Mate Reference type 2
MateEntity location = (-0.758985, 0.4382, 0)
MateEntity direction = (-0.866025, 0.5, 0)
MateEntity radii 1 and 2 = 0 0
comp name Outer tube_version3_ajp_june2014-1
Mate Reference type 11
MateEntity location = (0, 0, 0)
MateEntity direction = (1, 0, 0)
MateEntity radii 1 and 2 = 0 0
New axis is = (0.866025, -0.5, -0)
Overall rotation set to = (0, 3.14159, 2.61799)
comp name Outer tube assy_version4_mdh_mar14
Alignment = aligned
Type = coincident
Mate Reference type 4
MateEntity location = (-3.0485, 1.76005, 0)
MateEntity direction = (0, 0, 1)
MateEntity radii 1 and 2 = 0 0
comp name Outer tube_version3_ajp_june2014-1
Mate Reference type 4
MateEntity location = (0, 0, 0)
MateEntity direction = (0, 0, 1)
MateEntity radii 1 and 2 = 0 0
comp name Outer tube assy_version4_mdh_mar14
Alignment = anti-aligned
Type = coincident
Mate Reference type 2
MateEntity location = (-0.759226, 0.437783, 0)
MateEntity direction = (-0.866025, 0.5, -0)
MateEntity radii 1 and 2 = 0 0
comp name hv_outertube cone_ajp_version4_mdh_mar14-1
Mate Reference type 2
MateEntity location = (-0.733585, 0.482194, 0)
MateEntity direction = (0.866025, -0.5, 0)
MateEntity radii 1 and 2 = 0 0
```

For Outer tube\_version3\_ajp\_june2014-1  
correct rotation is:  
(1, 0, 0) to  
(0.866025, -0.5, -0)



# Solution to Rotation?

- If mate type is CLOSEST
  - › Use reversed direction of 2<sup>nd</sup> mate entity as destination and x-axis as source
- If mate type is ANTI\_ALIGNED
  - › and mate type is DATUMPLANES
    - Use reversed direction of 1st mate entity as destination and x-axis as source
- If mate type is ANTI\_ALIGNED and fewer than 3 mates
  - › Rotate direction of 1<sup>st</sup> mate entity into direction of 2<sup>nd</sup>
- Otherwise, if directions of a mate entity pair are +/- x-axis
  - › Rotate (1, 0, 0) into (0, 0, -1)



# New: Local Linear Pattern

- Lifting eyes have new feature: Local linear pattern
- Instead of having mates, they are placed in pattern
- Need to read pattern data from  
ILocalLinearPatternFeatureData
- Getting spacing values successfully
  - But failing to get axis

```
gCComPtr<IRefAxis> refAxis;  
hres = RefAxisDisp->QueryInterface(__uuidof(IRefAxis), reinterpret_cast<void**>(&refAxis));
```

>> Fails to find interface