The Results of Precision and Double Checking

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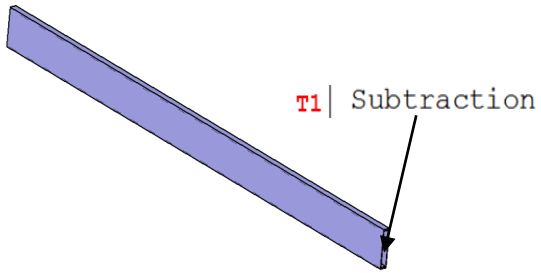
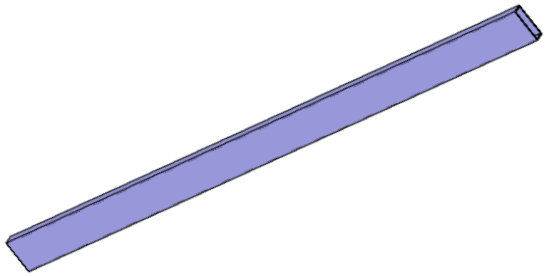
Test Example

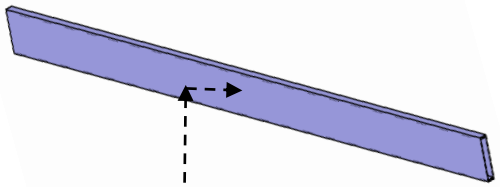
used for all following studies

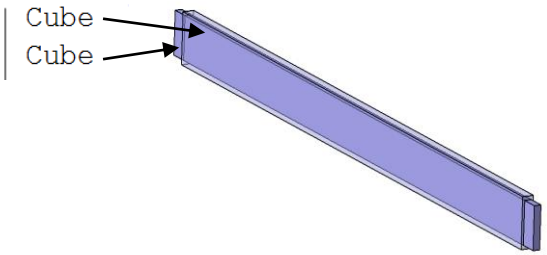
```
<box  name="TestExample_N11_Box1"  material="Aluminium"  X_Y_Z="3783.5 ; 230. ; 50. " />
<box  name="TestExample_N11_Box2"  material="Aluminium"  X_Y_Z="3790. ; 212. ; 43. " />

<subtraction name="TestExample_N11" >
   <posXYZ  volume="TestExample_N11_Box1"   X_Y_Z=" 0. ; 0. ; 0.  "  />
   <posXYZ  volume="TestExample_N11_Box2"   X_Y_Z=" 0. ; 0. ; 0. "  />
</subtraction>

<composition  name="TestExample_N11_Move" >
  <posXYZ  volume="TestExample_N11" X_Y_Z=" 0. ; 10570. ; -515." rot=" 0.; 0.; 0. " />
</composition>

<composition  name="ECT_Toroids" >
  <posXYZ  volume="TestExample_N11_Move" X_Y_Z=" 0. ; 0. ; 0." rot=" 0.; 0.; 22.5 " />
</composition>
```

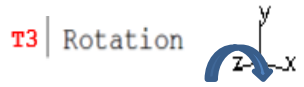
Cube
Cube
T1 Subtraction
T2 Move
T3 Rotation











Inaccuracies of Test Example

Final Results

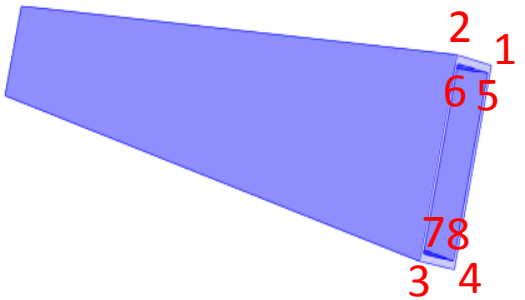
		GeoM Δ_1	G-4 Δ_2	Total Δ
1	x	0	0	0
	y	0	0	0
	z	0	0	0
2	x	0	0	0
	y	0	0	0
	z	0	0	0
3	x	0	0	0
	y	0	0	0
	z	0	0	0
4	x	0	0	0
	y	0	0	0
	z	0	0	0
5	x	0.03	0	0.03
	y	-0.08	0	-0.08
	z	-0.06	0	-0.06
6	x	0.03	0	0.03
	y	-0.08	0	-0.08
	z	-0.06	0	-0.06
7	x	0.03	0	0.03
	y	-0.08	0	-0.08
	z	-0.06	0	-0.06
8	x	0.03	0	0.03
	y	-0.08	0	-0.08
	z	-0.06	0	-0.06
Volume		0	0	0

Cube
Cube
T1 Subtraction
T2 Move
T3 Rotation

#01: Volume In the Axes Origin (without T2/T3)

		GeoM Δ_1	G-4 Δ_2	Total Δ
1	x	0	0	0
	y	0	0	0
	z	0	0	0
2	x	0	0	0
	y	0	0	0
	z	0	0	0
3	x	0	0	0
	y	0	0	0
	z	0	0	0
4	x	0	0	0
	y	0	0	0
	z	0	0	0
5	x	0	0	0
	y	-0.09	0	-0.09
	z	-0.06	0	-0.06
6	x	0	0	0
	y	-0.09	0	-0.09
	z	-0.06	0	-0.06
7	x	0	0	0
	y	-0.09	0	-0.09
	z	-0.06	0	-0.06
8	x	0	0	0
	y	-0.09	0	-0.09
	z	-0.06	0	-0.06
Volume		0	0	0

Cube
Cube
T1 Subtraction
T2 Move
T3 Rotation



GeoM is extracted from ***VP1***
G-4 is derived from ***GDML***

Inaccuracies of Test Example

#02: Volume without Rotation(without T3)

		GeoM Δ_1	G-4 Δ_2	Total Δ
1	x	0	0	0
	y	0	0	0
	z	0	0	0
2	x	0	0	0
	y	0	0	0
	z	0	0	0
3	x	0	0	0
	y	0	0	0
	z	0	0	0
4	x	0	0	0
	y	0	0	0
	z	0	0	0
5	x	0	0	0
	y	-0.09	-0.01	-0.1
	z	-0.06	0	-0.06
6	x	0	0	0
	y	-0.09	-0.01	-0.1
	z	-0.06	0	-0.06
7	x	0	0	0
	y	-0.09	-0.01	-0.1
	z	-0.06	0	-0.06
8	x	0	0	0
	y	-0.09	-0.01	-0.1
	z	-0.06	0	-0.06
Volume		0	0	0

	Cube
	Cube
T1	Subtraction
T2	Move
T3	Rotation

#03: Volume without Move (without T2)

		GeoM Δ_1	G-4 Δ_2	Total Δ
1	x	0	0	0
	y	0	0	0
	z	0	0	0
2	x	0	0	0
	y	0	0	0
	z	0	0	0
3	x	0	0	0
	y	0	0	0
	z	0	0	0
4	x	0	0	0
	y	0	0	0
	z	0	0	0
5	x	0.03	0	0.03
	y	-0.08	0.01	-0.07
	z	-0.06	0	-0.06
6	x	0.03	0	0.03
	y	-0.08	0.01	-0.07
	z	-0.06	0	-0.06
7	x	0.03	0	0.03
	y	-0.08	0.01	-0.07
	z	-0.06	0	-0.06
8	x	0.03	0	0.03
	y	-0.08	0.01	-0.07
	z	-0.06	0	-0.06
Volume		0	0	0

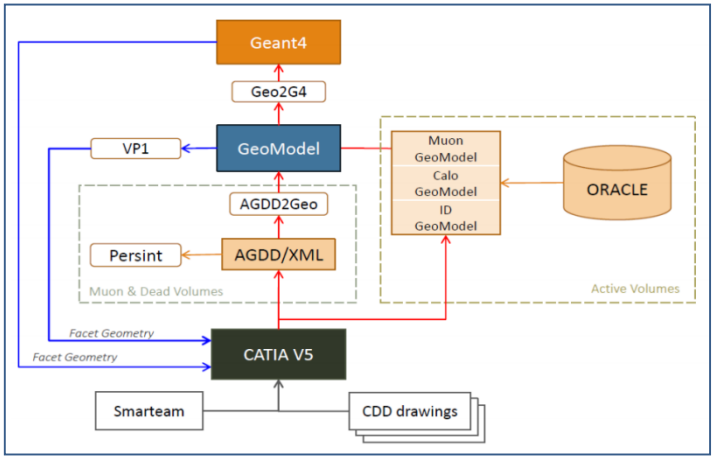
	Cube
	Cube
T1	Subtraction
T2	Move
T3	Rotation

GeoM is extracted from ***VP1***
G-4 is derived from ***GDML***

Sub Test Examples

I. Precision Checking

```
<box  name="TestExample_N11_Box1"  material="Aluminium"  X_Y_Z="3783.5 ; 230. ; 50. " />
<box  name="TestExample_N11_Box2"  material="Aluminium"  X_Y_Z="3790. ; 212. ; 43. " />

<subtraction name="TestExample_N11" >
   <posXYZ  volume="TestExample_N11_Box1"   X_Y_Z=" 0. ; 0. ; 0.  "  />
   <posXYZ  volume="TestExample_N11_Box2"   X_Y_Z=" 0. ; 0. ; 0. "  />
</subtraction>

<composition  name="TestExample_N11_Move" >
  <posXYZ  volume="TestExample_N11" X_Y_Z=" 0. ; 10570. ; -515." rot=" 0.; 0.; 0. " />
</composition>

<composition  name="ECT_Toroids" >
  <posXYZ  volume="TestExample_N11_Move" X_Y_Z=" 0. ; 0. ; 0." rot=" 0.; 0.; 22.5 " />
</composition>
```

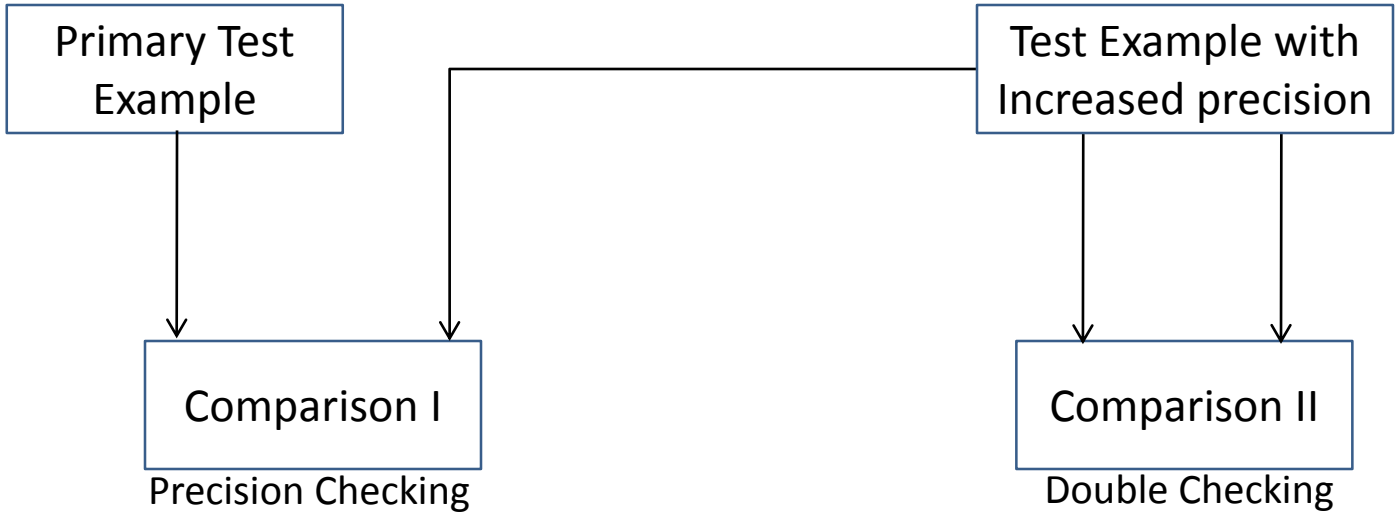



```
<box  name="TestExample_N11_Box1"  material="Aluminium"  X_Y_Z="3783.50000 ; 230.00000 ; 50.00000 " />
<box  name="TestExample_N11_Box2"  material="Aluminium"  X_Y_Z="3790.00000 ; 212.00000 ; 43.00000 " />

<subtraction name="TestExample_N11" >
   <posXYZ  volume="TestExample_N11_Box1"   X_Y_Z=" 0.00000 ; 0.00000 ; 0.00000  "  />
   <posXYZ  volume="TestExample_N11_Box2"   X_Y_Z=" 0.00000 ; 0.00000 ; 0.00000 "  />
</subtraction>

<composition  name="TestExample_N11_Move" >
  <posXYZ  volume="TestExample_N11" X_Y_Z=" 0.00000 ; 10570.00000 ; -515.00000" rot=" 0.00000; 0.00000; 0.00000 " />
</composition>

<composition  name="ECT_Toroids" >
  <posXYZ  volume="TestExample_N11_Move" X_Y_Z=" 0.00000 ; 0.00000 ; 0.00000" rot=" 0.00000; 0.00000; 22.50000 " />
</composition>
```

II. Double Checking

The 100% same Test Example was processed twice, but on 2 different lxplus machines

Result of Sub Test Examples



	Subtraction + Move + Rotation	Subtraction	Subtraction + Move	Subtraction + Rotation
Comparison I	X	X	√	√
Comparison II	X	X	X	X

X - Inaccuracies persist: there are no differences

√ - Inaccuracies gone: there are differences with previous results

Comparison I: Received result for Move

Primary Test Example

		GeoM Δ_1	G-4 Δ_2	Total Δ
1	x	0	0	0
	y	0	0	0
	z	0	0	0
2	x	0	0	0
	y	0	0	0
	z	0	0	0
3	x	0	0	0
	y	0	0	0
	z	0	0	0
4	x	0	0	0
	y	0	0	0
	z	0	0	0
5	x	0	0	0
	y	-0.09	-0.01	-0.1
	z	-0.06	0	-0.06
6	x	0	0	0
	y	-0.09	-0.01	-0.1
	z	-0.06	0	-0.06
7	x	0	0	0
	y	-0.09	-0.01	-0.1
	z	-0.06	0	-0.06
8	x	0	0	0
	y	-0.09	-0.01	-0.1
	z	-0.06	0	-0.06
Volume		0	0	0

Test Example with increased Precision

		GeoM Δ_1	G-4 Δ_2	Total Δ
1	x	0	0	0
	y	0	0	0
	z	0	0	0
2	x	0	0	0
	y	0	0	0
	z	0	0	0
3	x	0	0	0
	y	0	0	0
	z	0	0	0
4	x	0	0	0
	y	0	0	0
	z	0	0	0
5	x	0	0	0
	y	-0.09	0	-0.09
	z	-0.06	0	-0.06
6	x	0	0	0
	y	-0.09	0	-0.09
	z	-0.06	0	-0.06
7	x	0	0	0
	y	-0.09	0	-0.09
	z	-0.06	0	-0.06
8	x	0	0	0
	y	-0.09	0	-0.09
	z	-0.06	0	-0.06
Volume		0	0	0

The inaccuracies of movement have been disappeared after rising precision

Comparison I: Received result for Rotation

Primary Test Example

		GeoM Δ_1	G-4 Δ_2	Total Δ
1	x	0	0	0
	y	0	0	0
	z	0	0	0
2	x	0	0	0
	y	0	0	0
	z	0	0	0
3	x	0	0	0
	y	0	0	0
	z	0	0	0
4	x	0	0	0
	y	0	0	0
	z	0	0	0
5	x	0.03	0	0.03
	y	-0.08	0.01	-0.07
	z	-0.06	0	-0.06
6	x	0.03	0	0.03
	y	-0.08	0.01	-0.07
	z	-0.06	0	-0.06
7	x	0.03	0	0.03
	y	-0.08	0.01	-0.07
	z	-0.06	0	-0.06
8	x	0.03	0	0.03
	y	-0.08	0.01	-0.07
	z	-0.06	0	-0.06
Volume		0	0	0

Test Example with increased Precision

		GeoM Δ_1	G-4 Δ_2	Total Δ
1	x	0	0	0
	y	0	0	0
	z	0	0	0
2	x	0	0	0
	y	0	0	0
	z	0	0	0
3	x	0	0	0
	y	0	0	0
	z	0	0	0
4	x	0	0	0
	y	0	0	0
	z	0	0	0
5	x	0.03	0	0.03
	y	-0.08	0	-0.08
	z	-0.06	0	-0.06
6	x	0.03	0	0.03
	y	-0.08	0	-0.08
	z	-0.06	0	-0.06
7	x	0.03	0	0.03
	y	-0.08	0	-0.08
	z	-0.06	0	-0.06
8	x	0.03	0	0.03
	y	-0.08	0	-0.08
	z	-0.06	0	-0.06
Volume		0	0	0

The inaccuracies of Rotation have been disappeared after rising precision

Conclusion

- Inaccuracies persist for geometry representation derived from VP1
  - Most likely hard to solve

- Geometry representation from GDML shows less inaccuracies when precision is increased
  - (Muon) Simulation team should follow up and increase precision

- Still to be understood inaccuracy for simple subtraction

Thank you for your attention

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