

STLCutter.jl

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<http://github.com/pmartorell/STLCutters.jl>

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Performed tests

Experiments from issue #11

3. Thingi 10k dataset

Filtered 5k geometries with
quality criteria

(closed, oriented, non
degenerate...)

Tests:

- ▶ Background mesh: 100 cells
in largest direction
- ▶ Gadi, Titani (HPCs)

1.1,2.1. Robustness Matrix

Matrix axis:

- ▶ 13 geometries
- ▶ 6 background mesh
h-refinements: $14 \times 2^{(0:5)}$
- ▶ 1 origin + 17 displacements
+ 17 rotation : $10^{(-17:-1)}$

Thingiverse 10k dataset

Few numbers

Num geometries: 5052

Not available: 312 (6.2% of total)

Load error: 7 (0.14% of total)

Available: $5052 - 312 - 7 = 4733$ (93.7% of total)

Success geometries: 3817 (78.5% of available, 97.4% of launched)

Large volume error ($>1e-14$): 67 (1.8% of success) (100% due to small facets)

Found to be degenerated: 4

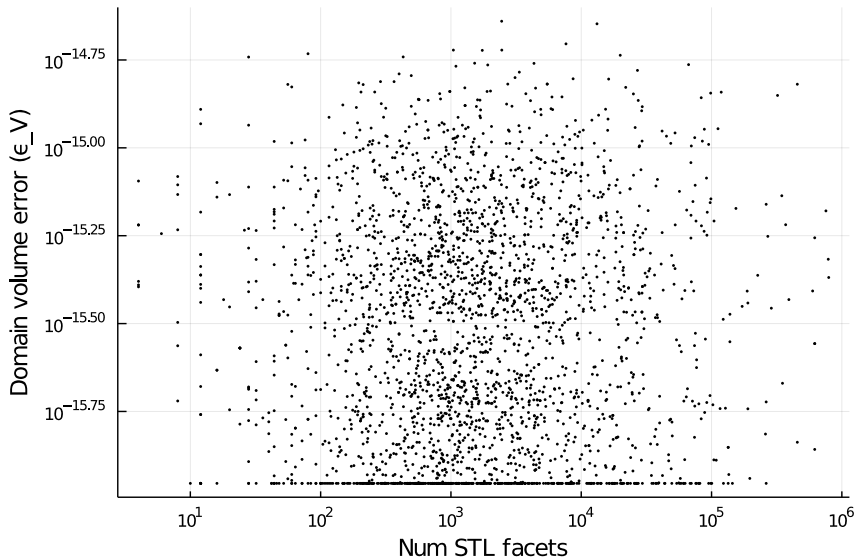
Failed: 34 (0.89% of success)

Missing (running): 916 (19.4% of total)

ONGOING: Try to fix problems with small facets Identify failed runs as degenerate or fix

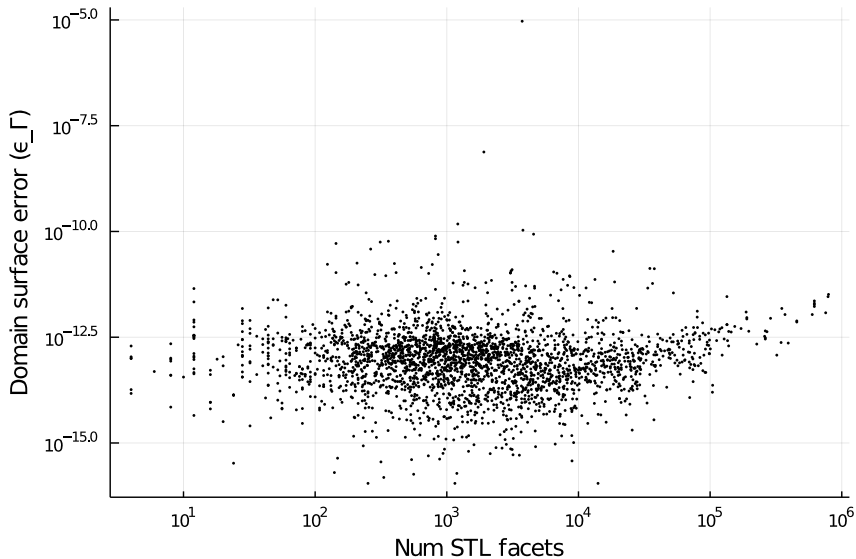
Thingi 10k dataset

Removing small facets



Thingi 10k dataset

Removing small facets



Robustness matrix

Summary

100% of ended test have volume and surface error bounded
($\epsilon_{vol} < 10^{-14}$, $\epsilon_{surf} < 10^{-12}$)

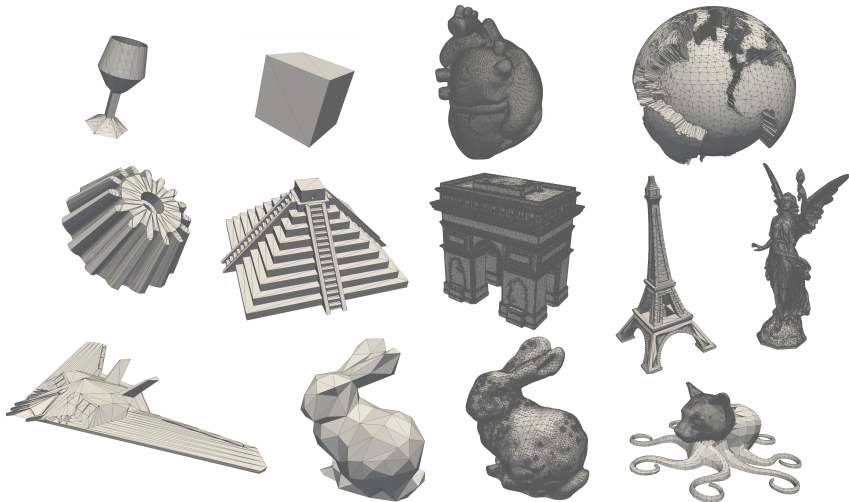
The mesh sizes have n_{max} multiple of 14 as the bounding box is expanded a factor 0.2 in each direction, thus the domain is 1.4 times the bounding box per axis. The background cells will match the STL bounding box, stressing even more the algorithm.

NOTE: Due to large computational requirements (time/memory), some tests have not ended. Those points are missing at the lowest and largest sizes.

- ▶ Low n_{max} : large amount of STL facets per cell
- ▶ High n_{max} : large background mesh

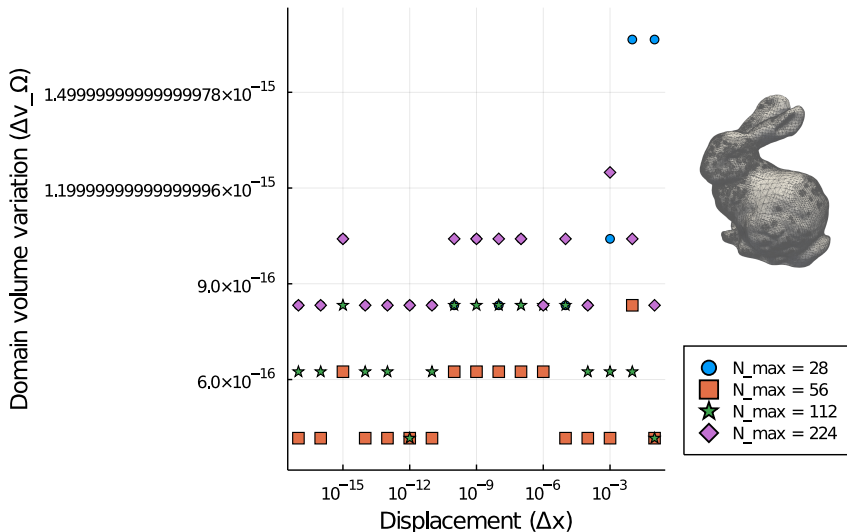
Robustness matrix

Geometries



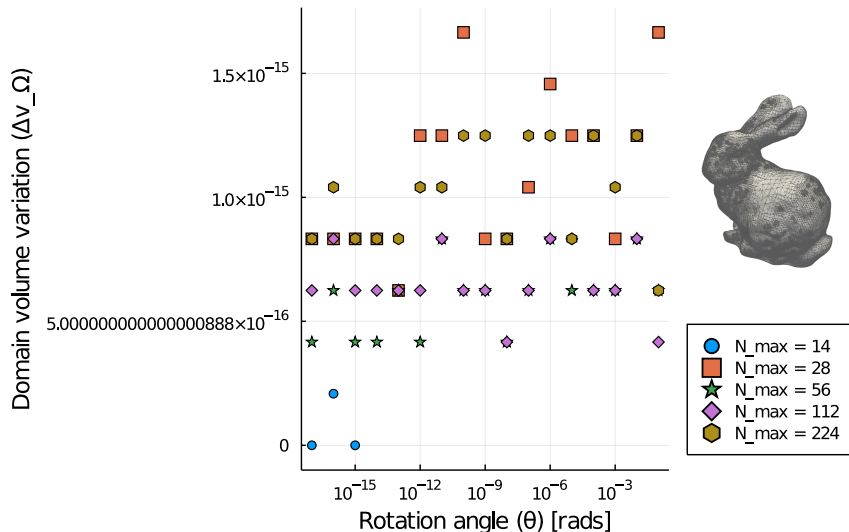
Robustness matrix

name_441708_x_displacement_y_domain_volume



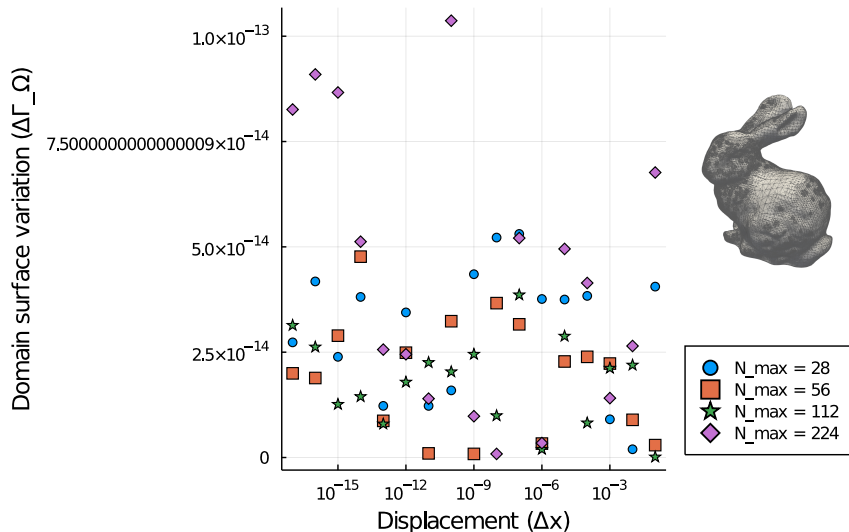
Robustness matrix

name_441708_x_rotation_y_domain_volume



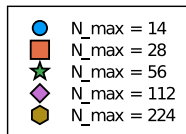
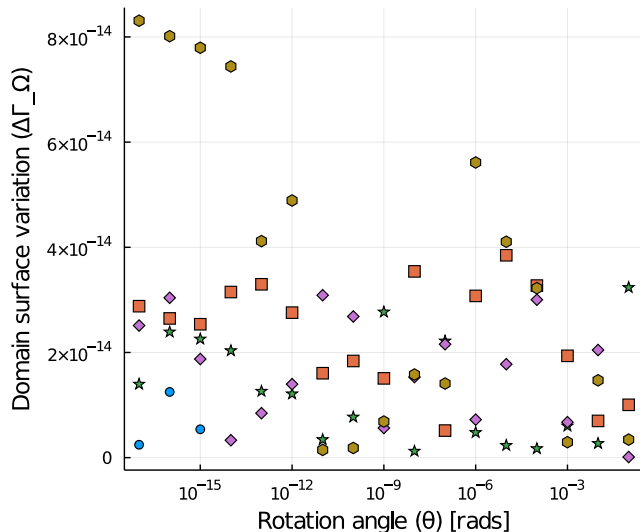
Robustness matrix

name_441708_x_displacement_y_domain_surface



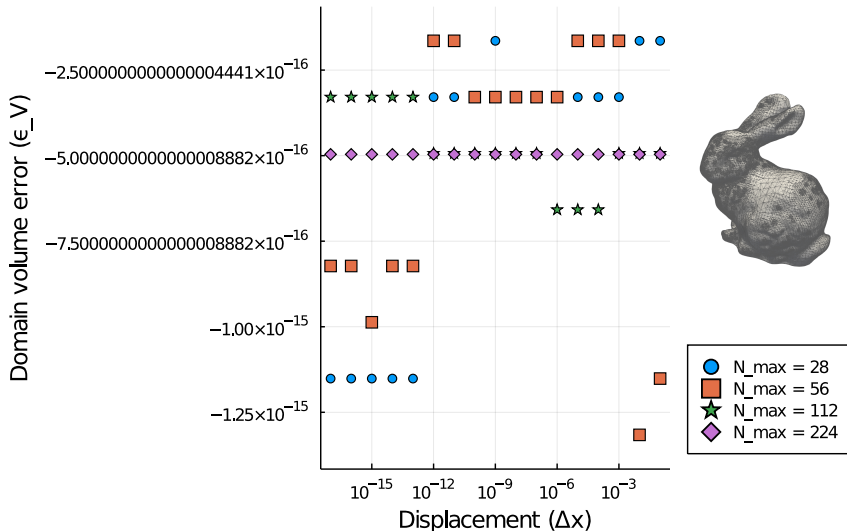
Robustness matrix

name_441708_x_rotation_y_domain_surface



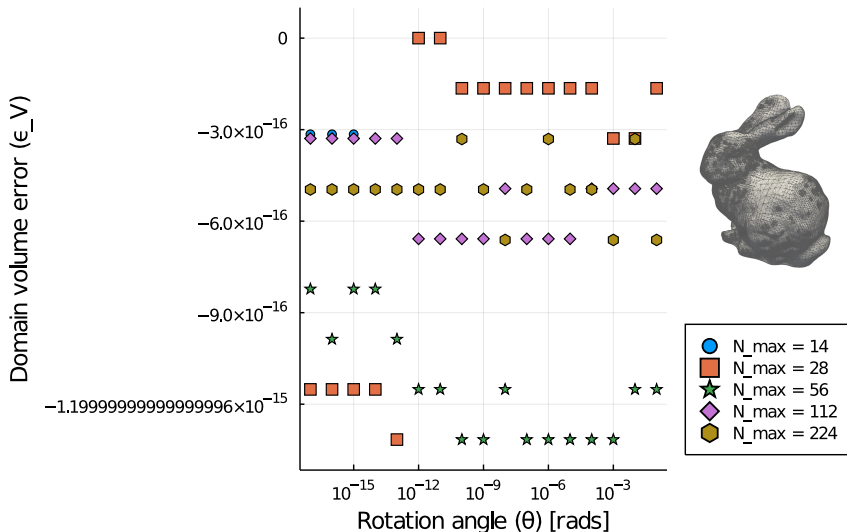
Robustness matrix

name_441708_x_displacement_y_volume_error



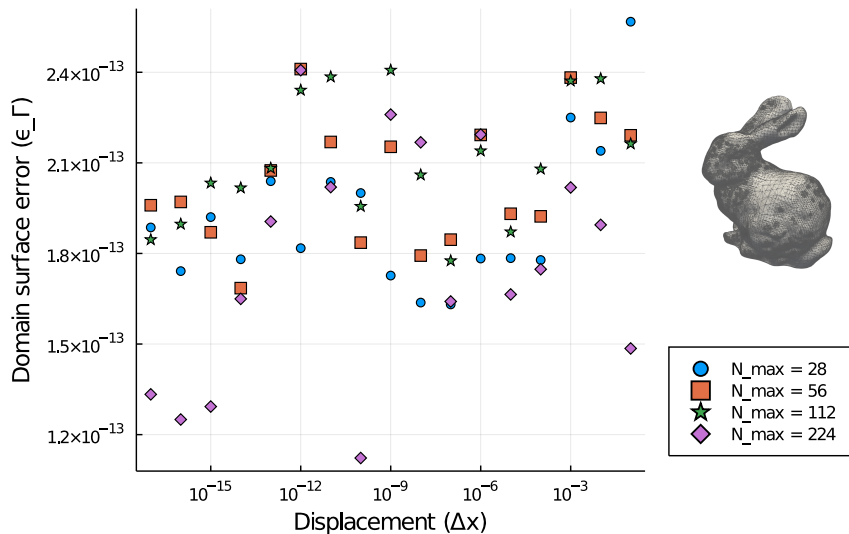
Robustness matrix

name_441708_x_rotation_y_volume_error



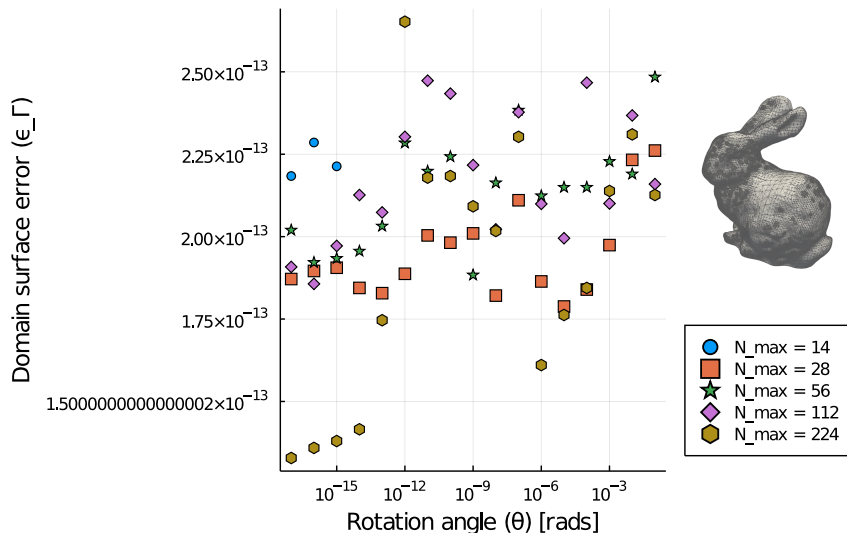
Robustness matrix

name_441708_x_displacement_y_surface_error

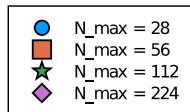
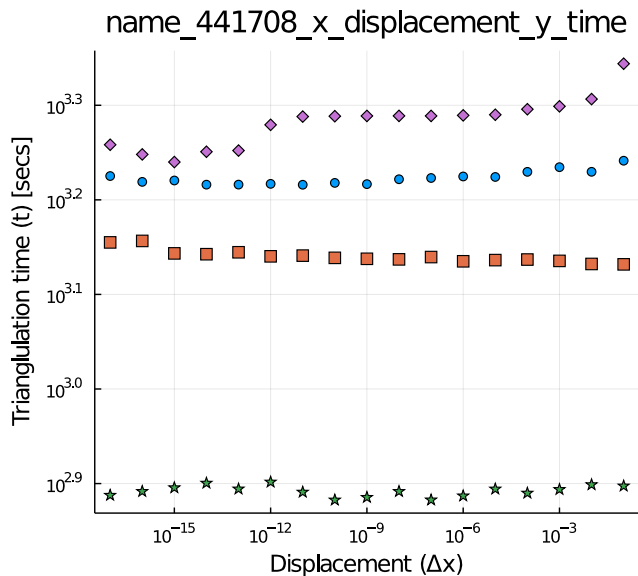


Robustness matrix

name_441708_x_rotation_y_surface_error

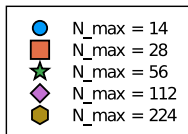
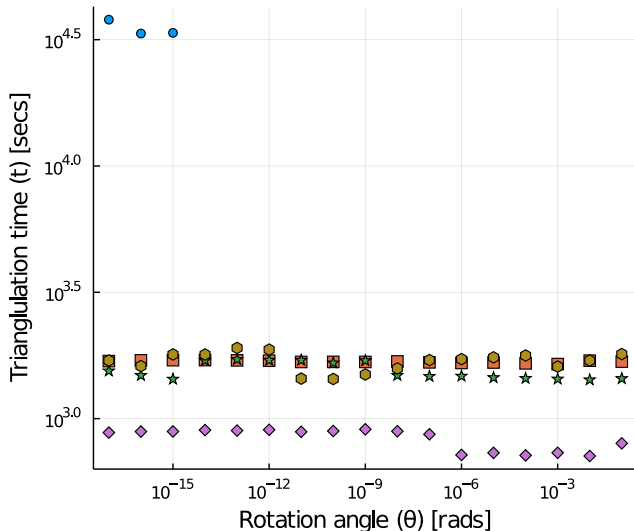


Robustness matrix



Robustness matrix

name_441708_x_rotation_y_time



Robustness matrix

Collected results:

- ▶ Domain Volume Variation
- ▶ Domain Surface Variation
- ▶ Domain Volume Error
- ▶ Surface Error
- ▶ CPU time (not accurate)
- ▶ {Min,Max,Avg} num subcells per cell

Conclusions and pending work

Conclusion so far

- ▶ Issues are depending on the geometry
- ▶ Most of problematic geometries can be found *a priori*

Ongoing work

- ▶ Detect true degenerated geometries
- ▶ Run Gridap