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SIAM IMR26: March 3-6, 2026

## **Eigenforms of the Brandenburg Gate**

Meshing contest

Application of the 2 500 000 tetra

Multigrid Marching Tetra mesh

to Nastran/CalculiX Eigenforms

## Preliminaries

Download glb binary data, 224 MB

Creating stl by a free (glb to stl) converter

Coarsen stl by MEDINA Coarsen to reduce the  
geometry effort in LFE-MMT

527 000 to 244 000 nodes  
1 056 000 to 490 000 triangles

Creating a floor to obtain a closed surface.

No repair of the damaged pillar

## Running LFE-MMT

Release DVLP 7 , 2022

12 adaptive refinements fluid+solid tetras

0	1
1	8
2	64
...	
10	338 000
11	1 181 000
12	4 139 000

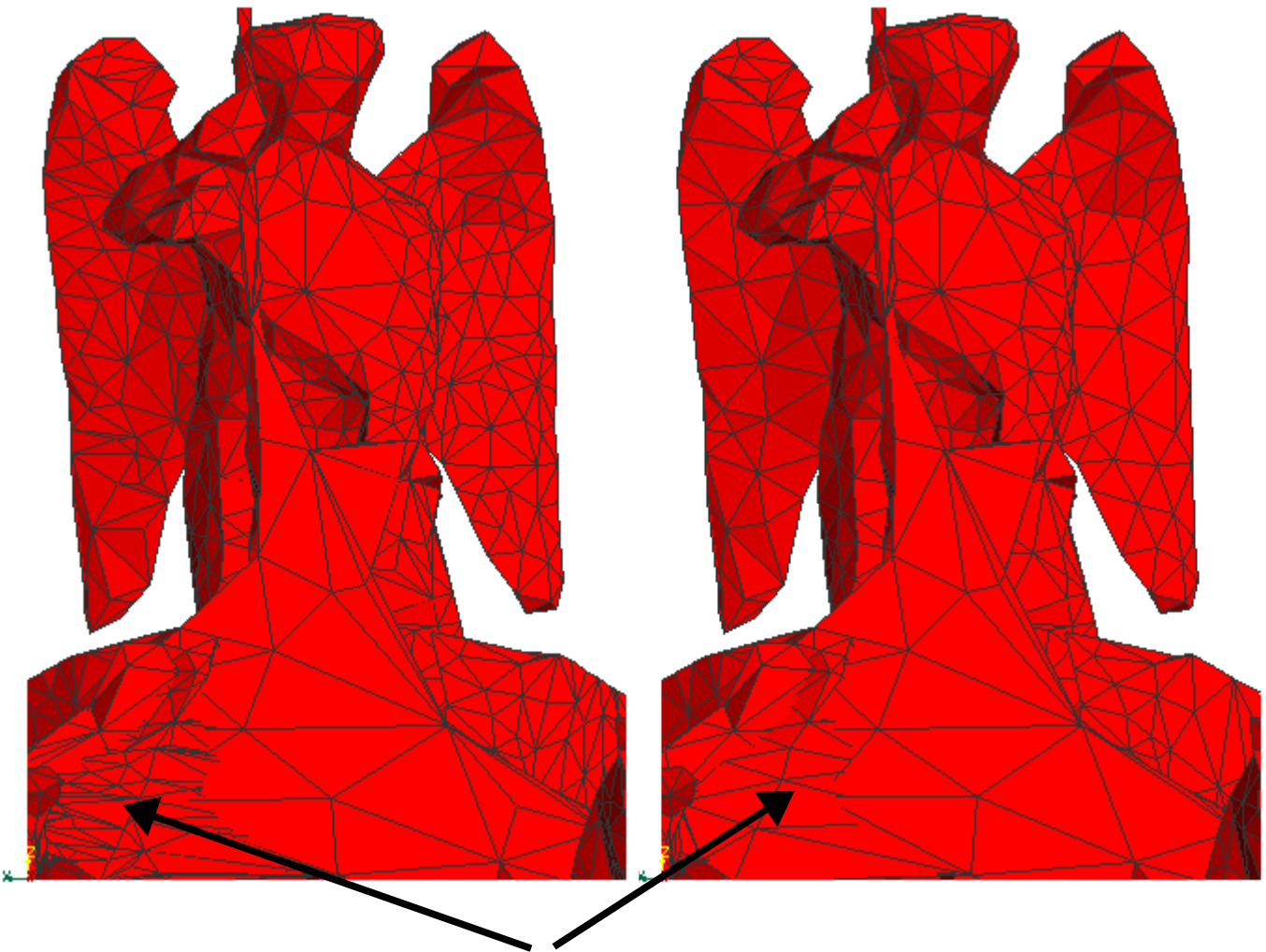
## Running Nastran/Calculix modal analysis

Linear tetras do not work. Elements are transformed  
To quadratic elements with linear midnodes.

Bypassing very poor elements.

## Postprocessing

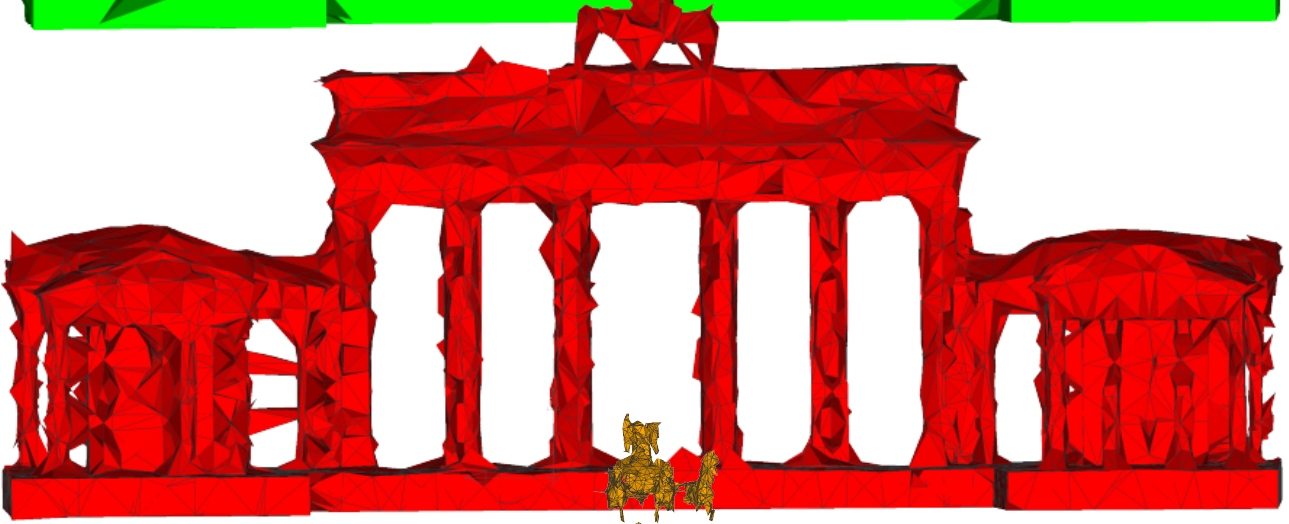
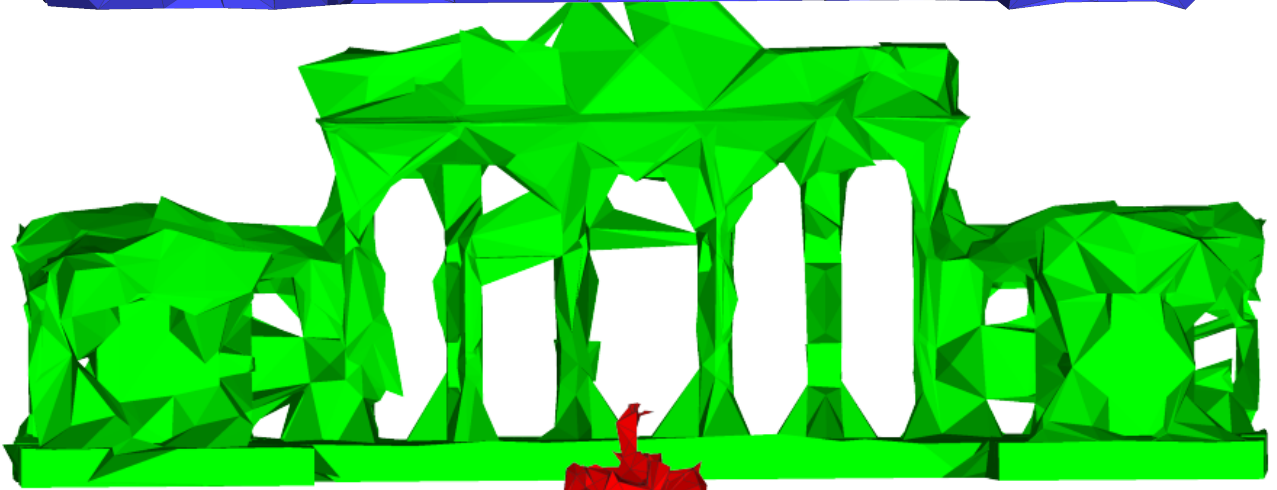
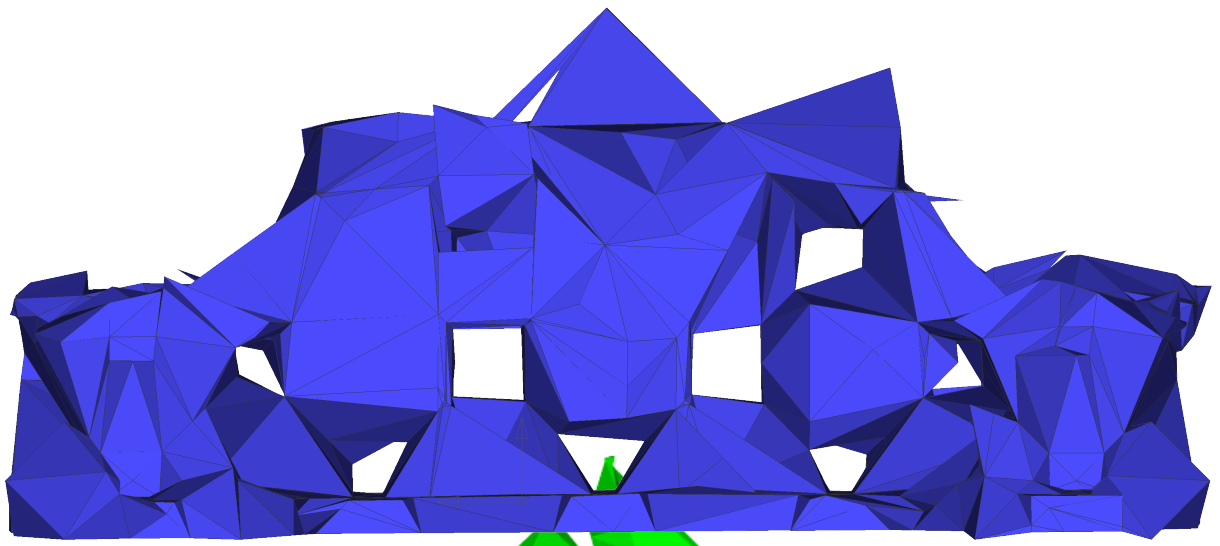
Comparing 11 vs 12 Iterations: no visible difference



penetrating data are coarsened correctly.

Coarsen stl by MEDINA Coarsen

527 000 to 244 000 nodes



## Bypassing very poor elements

The current Multigrid Marching Tetra algorithm concludes with a mesh improvement step.

4 100 000 Tetras (fluid and solid)

0.29 average element quality \*

6.1 % tetras worse than 0.05

6.2 e-7 worst tetra

( MMT allows for better elements at the cost of geometric inaccuracies)

We start with the unmodified mesh, Nastran/Calculix provides a list of 20 very poor elements.

These elements are simply deleted.

The second Nastran/Calculix run produces the result shown on the next page.

\* Tetra quality = constant \* Volume / max edge \*\*3 . Best = 1.0



view to the east and to the west