The Space *Filling Curve* Needle

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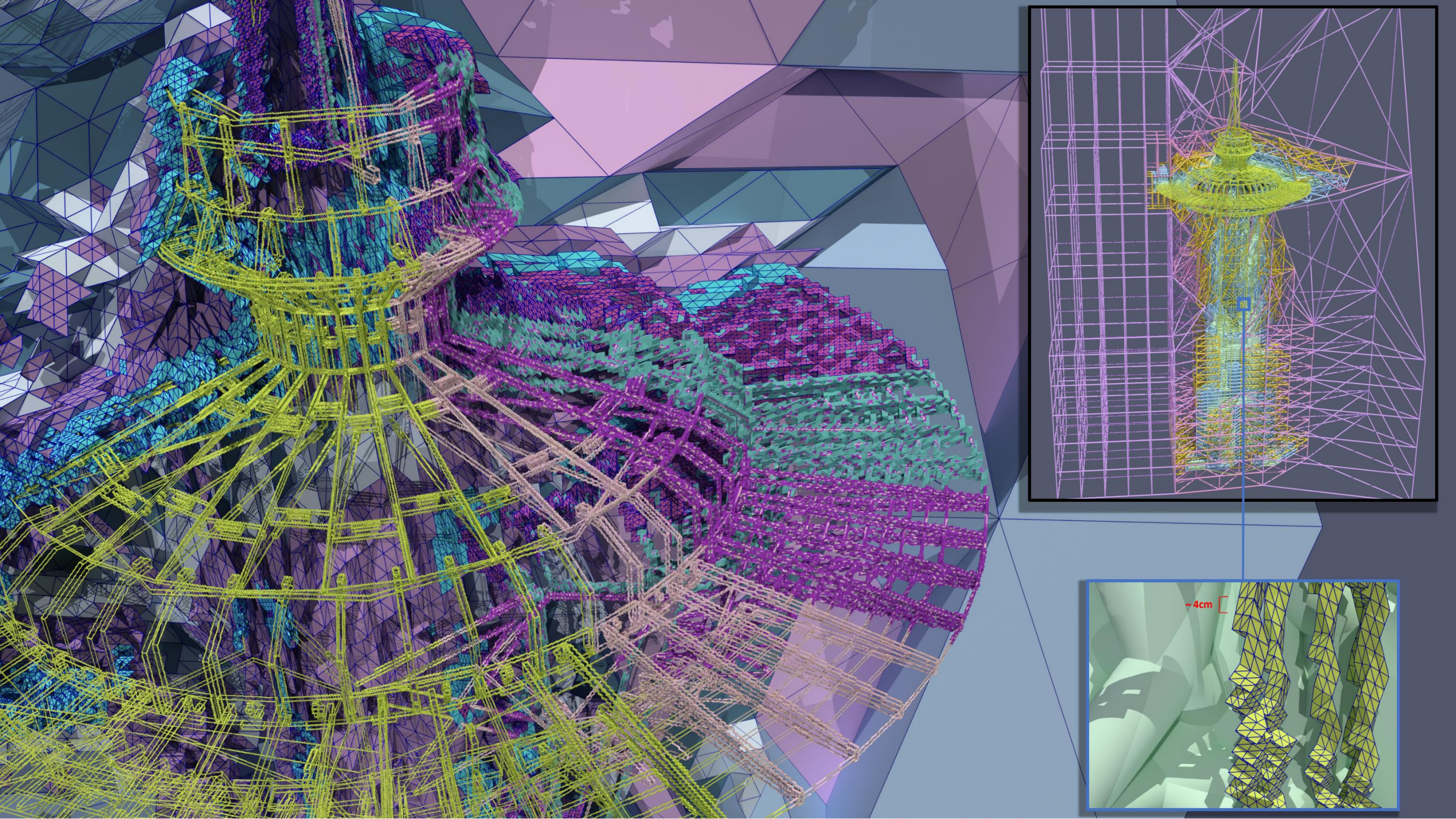
~4cm

We see a cut through a hierarchical adaptive mesh created with the AMR software t8code[1] and visualized with Paraview. The colors represent different refinement levels.

The mesh consists of 82,119,322 elements: 74,113,297 tetrahedra, 952,019 hexahedra, 6,727,231 prisms and 326,775 pyramids. It was created on 56 processes in parallel in 21.2 seconds.

t8code uses a forest-of-trees approach that was up to recently exclusively available to hexahedral meshes. The elements are stored using a space-filling curve integer index which requires only minimal amounts of memory while allowing for full mesh flexibility and scalability of the mesh management algorithms. Our space needle mesh is one of the first examples showing space-filling curve adaptive mesh refinement for pyramid elements.

For this special adaptation criterion the 1D space needle skeleton is embedded in a (distributed) coarse 3D mesh of 40,198 elements. We then recursively refine each 3D mesh element if it is cut by the space needle geometry until the final refinement level of 11 is reached; the finest level shown in the picture is level 10.

Starting with element diameters of 5-10 meters on the coarsest level, the refinement brings the resolution down to under 2 centimeters at the finest level.

[1] www.github.com/holke/t8code