Meshing for Multimaterial Biological Volumes

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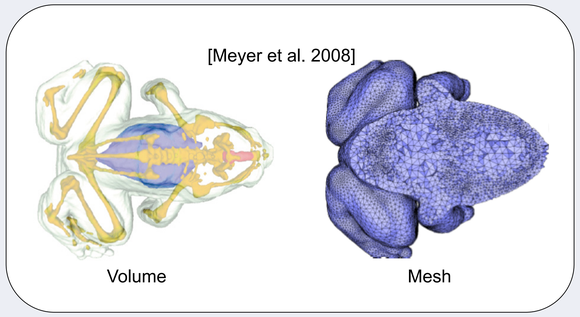
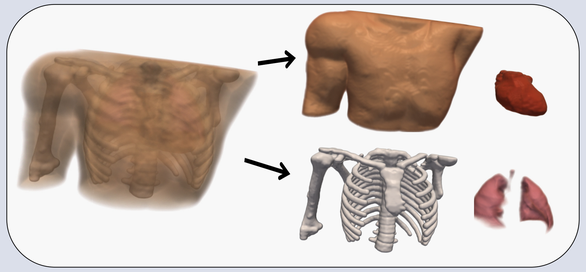
Medical Meshing

Volumetric data, such as CT or MRI scans, are some of the best sources of biological data. Unfortunately, these 3D images are not suitable for numerical simulations. Instead, researchers prefer geometric models, referred to as ‘Meshes’. These meshes are often composed of triangles in 2D, and tetrahedra in 3D.

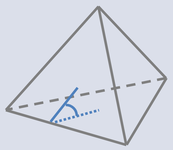


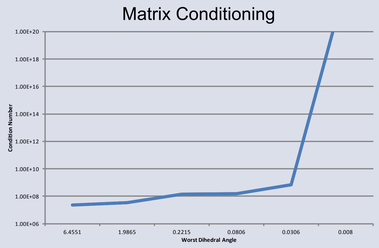
Quality

A key challenge to ‘meshing’ volumetric data, is preserving boundaries between different materials. These boundaries are ill-defined, but failing to capture them can break simulations outright. Our current work is capable of capturing any number of interacting materials.



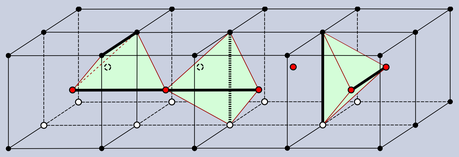
Biomedical simulations typically employ the Finite Element Method. It is well known that quality of the finite elements affects the numerical stability of the method. For tetrahedra, this quality is intrinsically linked to their dihedral angles.





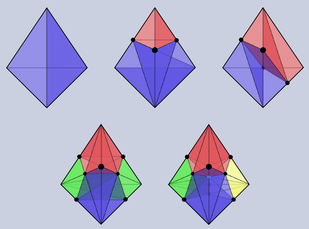
Approach

Start with high quality tetrahedral lattice

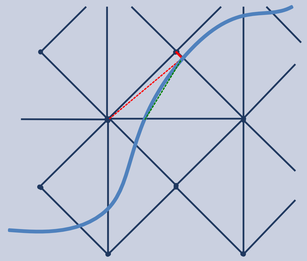


Body Centered Cubic Lattice

Cut/Cleave lattice into small set of ‘stencils’, tetrahedra that conform to surfaces.



Warp lattice to remove poor quality tetrahedra.



Results