

Biomesh3D - Demo

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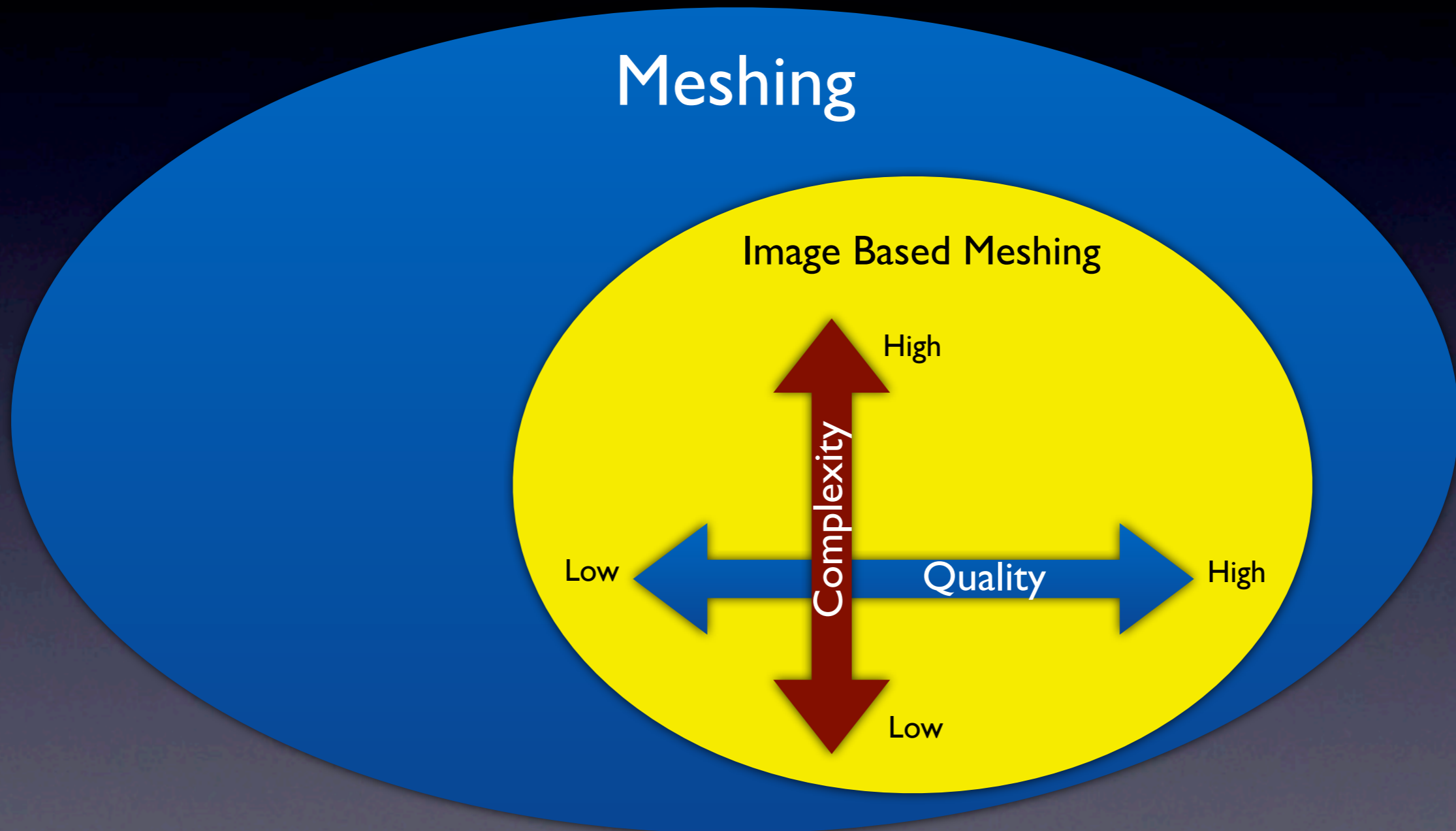


When To Use BM3D

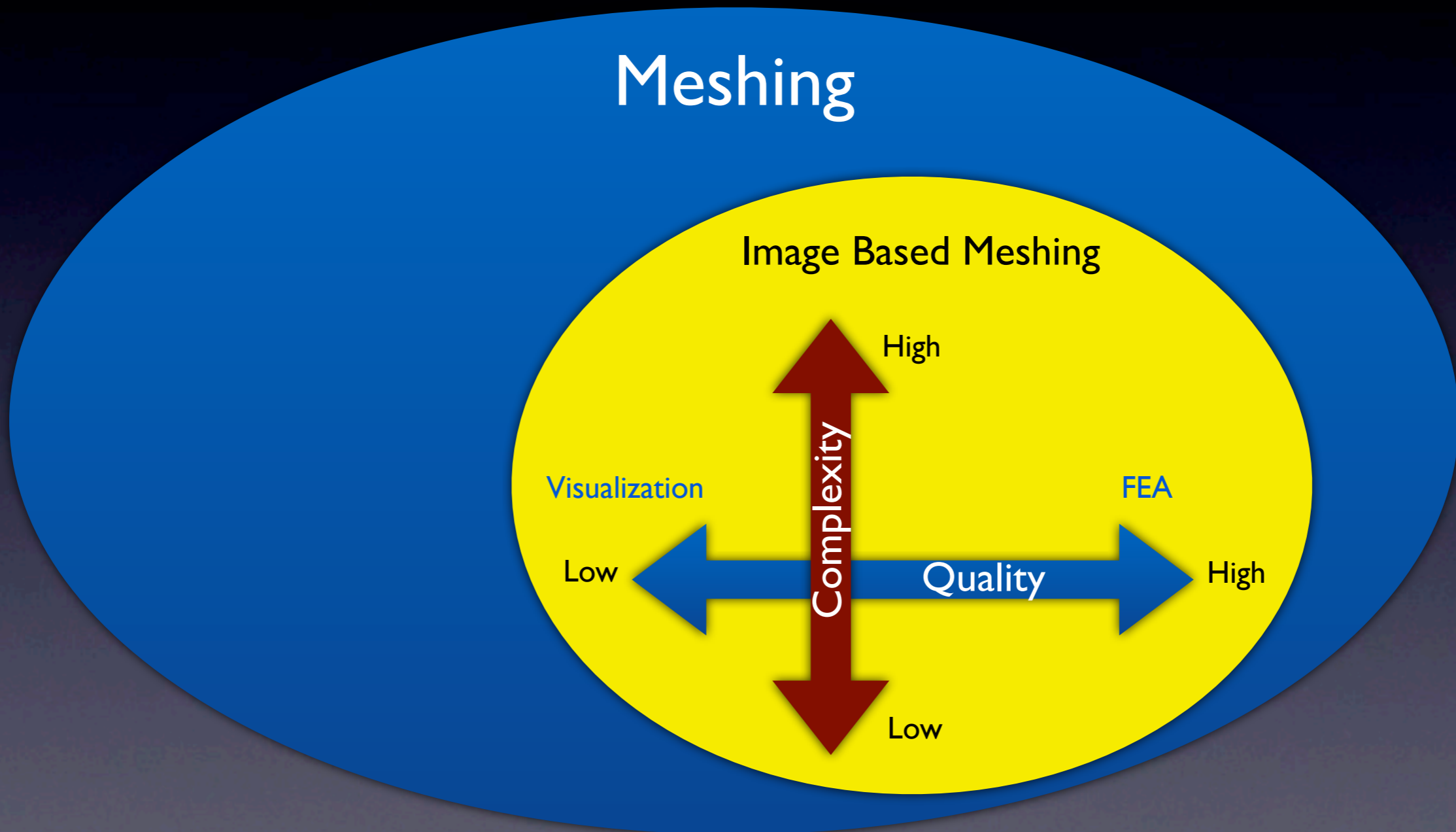
Meshing

Image Based Meshing

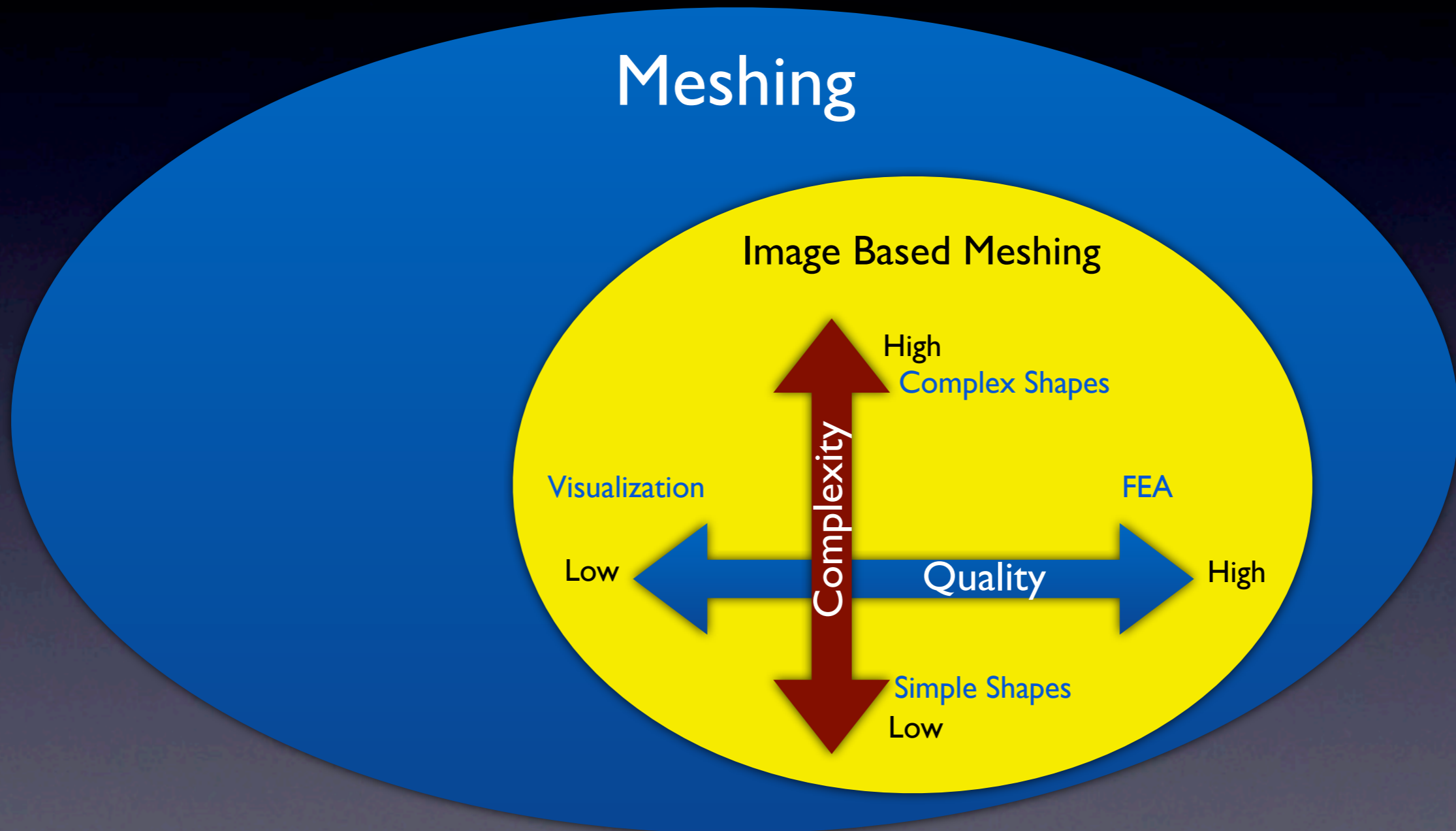
When To Use BM3D



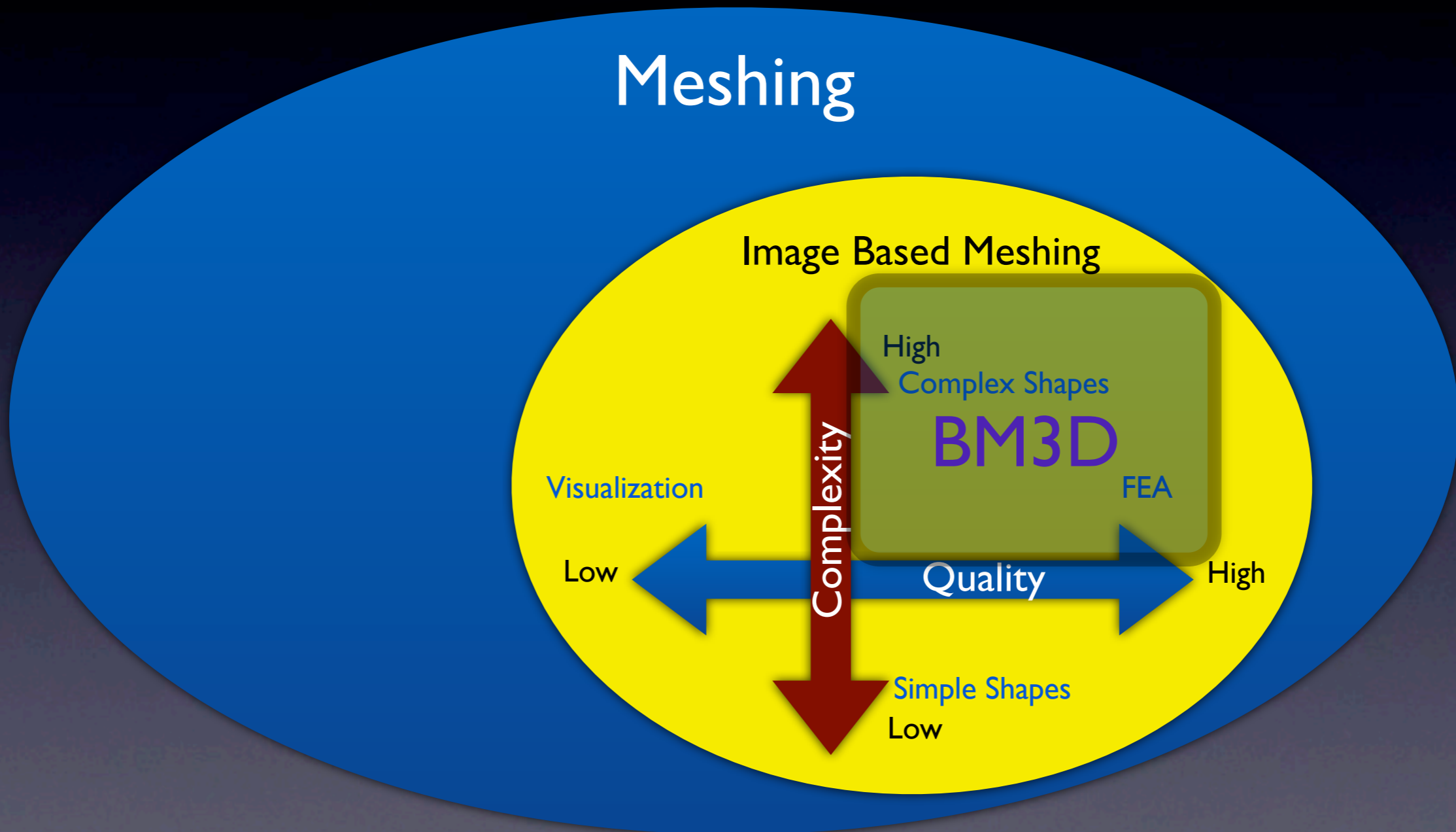
When To Use BM3D



When To Use BM3D



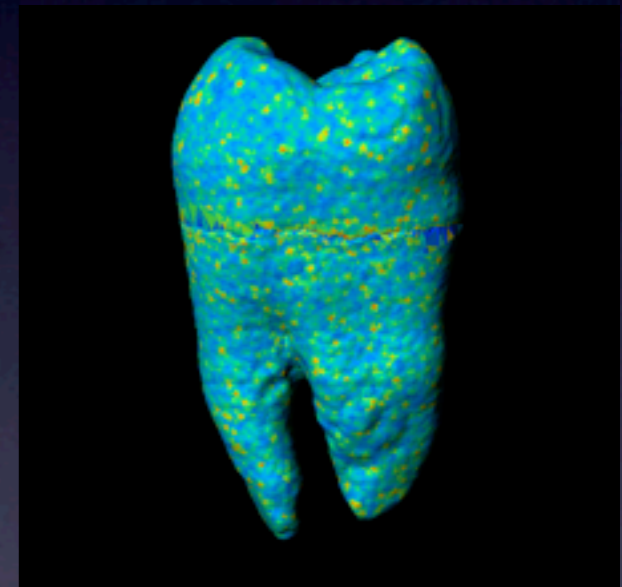
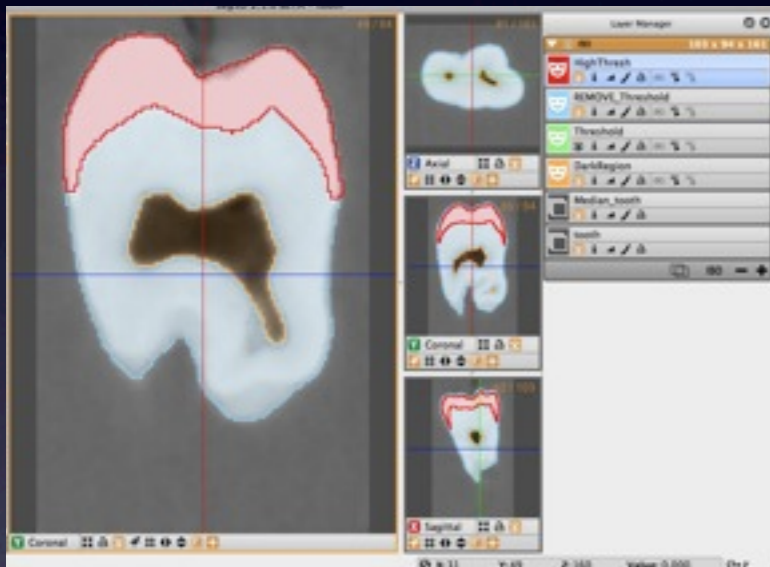
When To Use BM3D



Biomesh3D

Segmentation

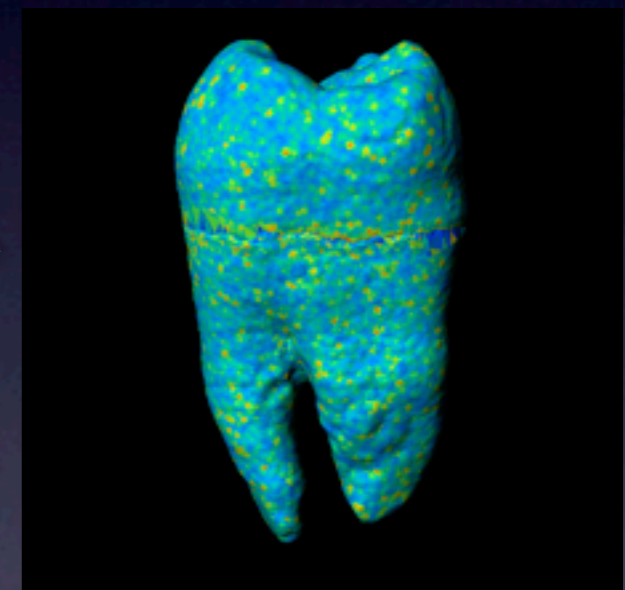
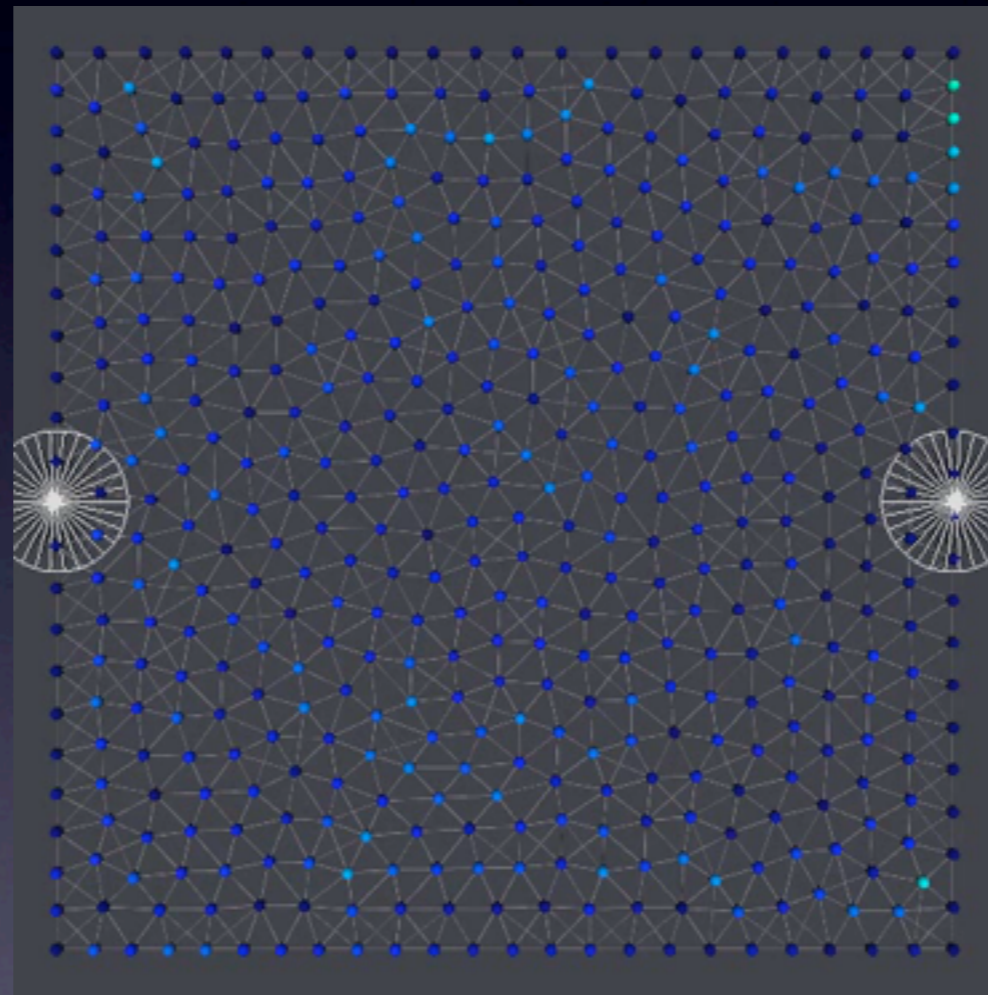
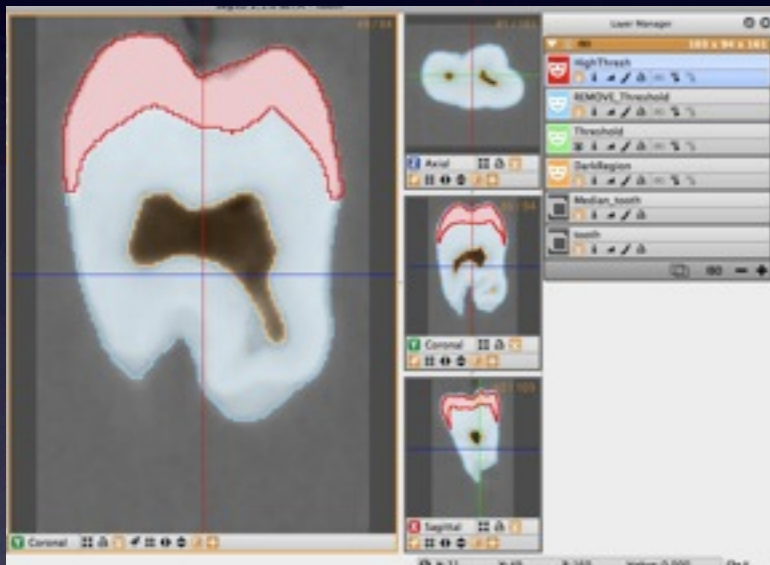
Tetrahedral Mesh



Biomech3D

Segmentation

Tetrahedral Mesh



Steps of BM3D

1. Preprocess Segmentation
2. Tighten or smooth
3. Medial Axis
4. Sizing Field
5. Seed Surface
6. Particle System
7. Generate Surfaces
8. Generate Volume Mesh

Steps of BM3D

1. Preprocess Segmentation

- Reads a .nrrd from Seg3D
- Each Label is a different material

2. Tighten or smooth

3. Medial Axis

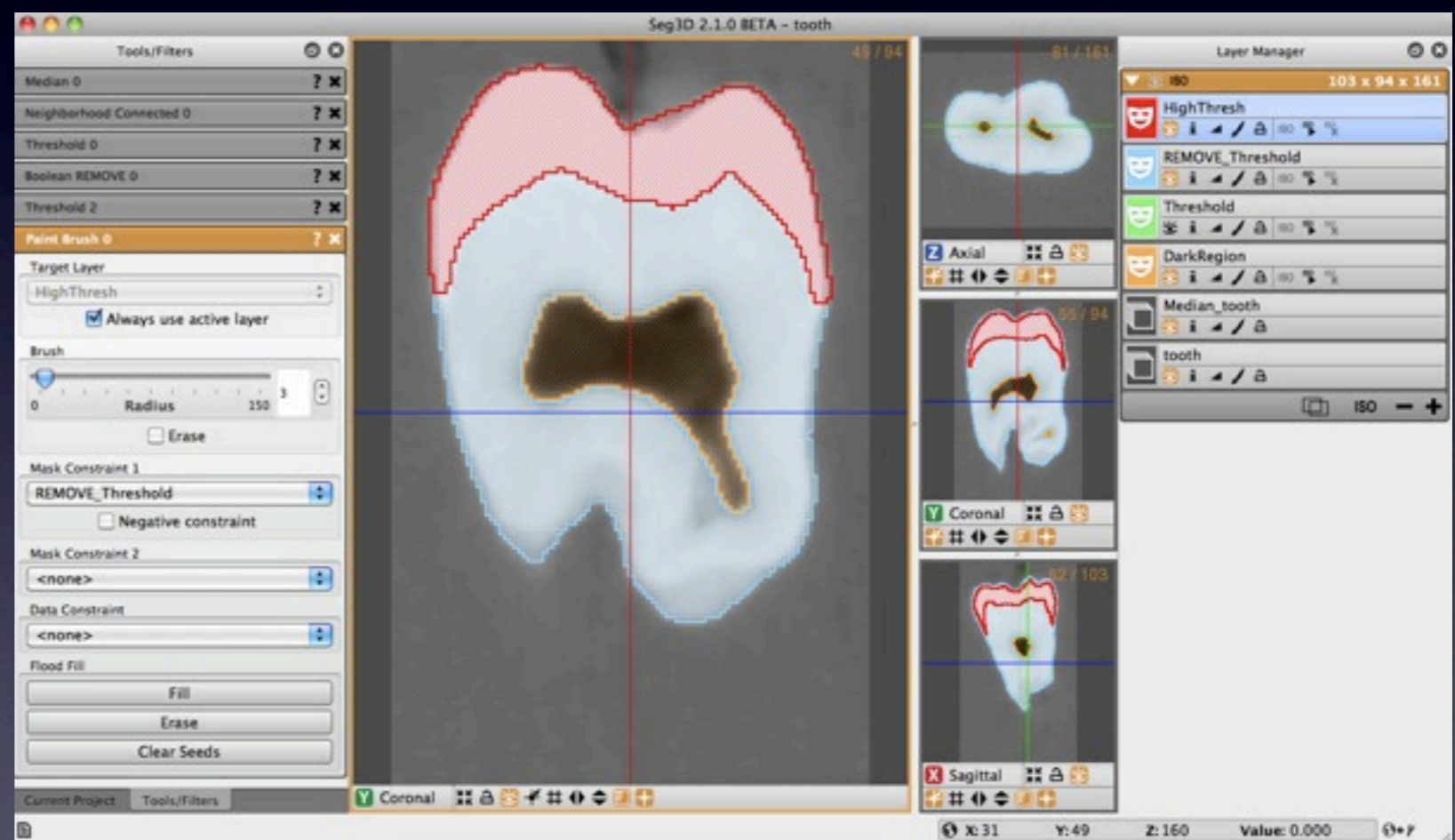
4. Sizing Field

5. Seed Surface

6. Particle System

7. Generate Surfaces

8. Generate Volume Mesh



Steps of BM3D

1. Preprocess Segmentation

Curvature limiting geometric simplification

2. Tighten or smooth

3. Medial Axis

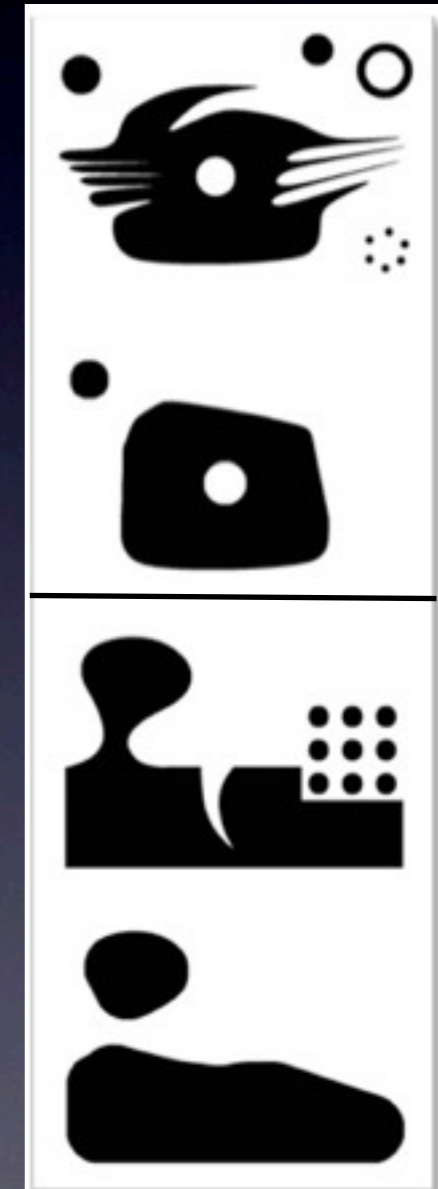
4. Sizing Field

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A. Chica, J. Williams, et. al. Pressing: Smooth isosurfaces with flats from binary grids. *Computer Graphics Forum* 27(1), 2007.

J. Williams. Relative convexity and the medial cover. *Fall Workshop on Computational Geometry*, 2008.

Steps of BM3D

1. Preprocess Segmentation

2. Tighten or smooth

3. Medial Axis

4. Sizing Field

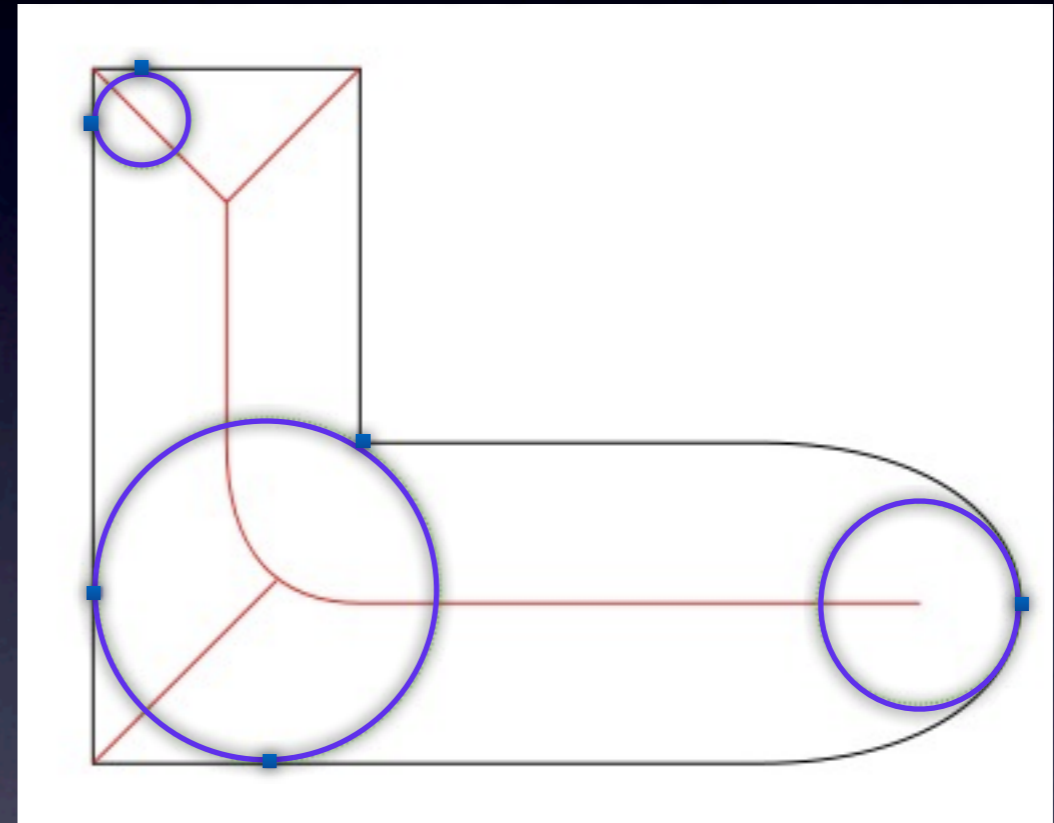
5. Seed Surface

6. Particle System

7. Generate Surfaces

8. Generate Volume Mesh

Identifies corners and thin features



By Pblanke (Own work) [Public domain],
via Wikimedia Commons

Steps of BM3D

1. Preprocess Segmentation
2. Tighten or smooth
3. Medial Axis
- 4. Sizing Field**
5. Seed Surface
6. Particle System
7. Generate Surfaces
8. Generate Volume Mesh

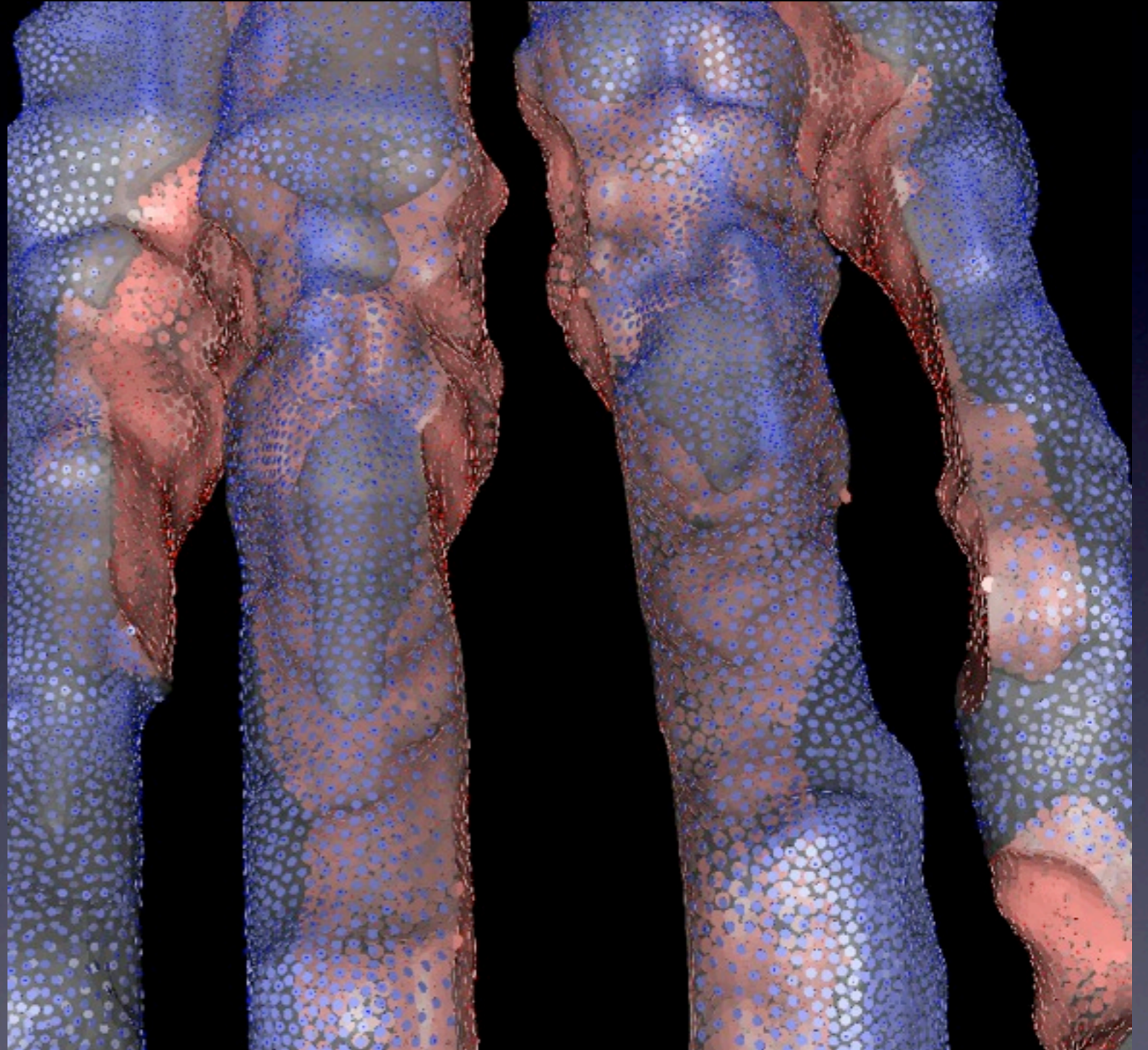


Steps of BM3D

1. Preprocess Segmentation
2. Tighten or smooth
3. Medial Axis
4. Sizing Field
- 5. Seed Surface**
6. Particle System
7. Generate Surfaces
8. Generate Volume Mesh

Steps of BM3D

1. Preprocess Segmentation
2. Tighten or smooth
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5. Seed Surface
- 6. Particle System**
7. Generate Surfaces
8. Generate Volume Mesh



Steps of BM3D

1. Preprocess Segmentation
2. Tighten or smooth
3. Medial Axis
4. Sizing Field
5. Seed Surface
6. Particle System
- 7. Generate Surfaces**
8. Generate Volume Mesh

Steps of BM3D

1. Preprocess Segmentation

2. Tighten or smooth

3. Medial Axis

4. Sizing Field

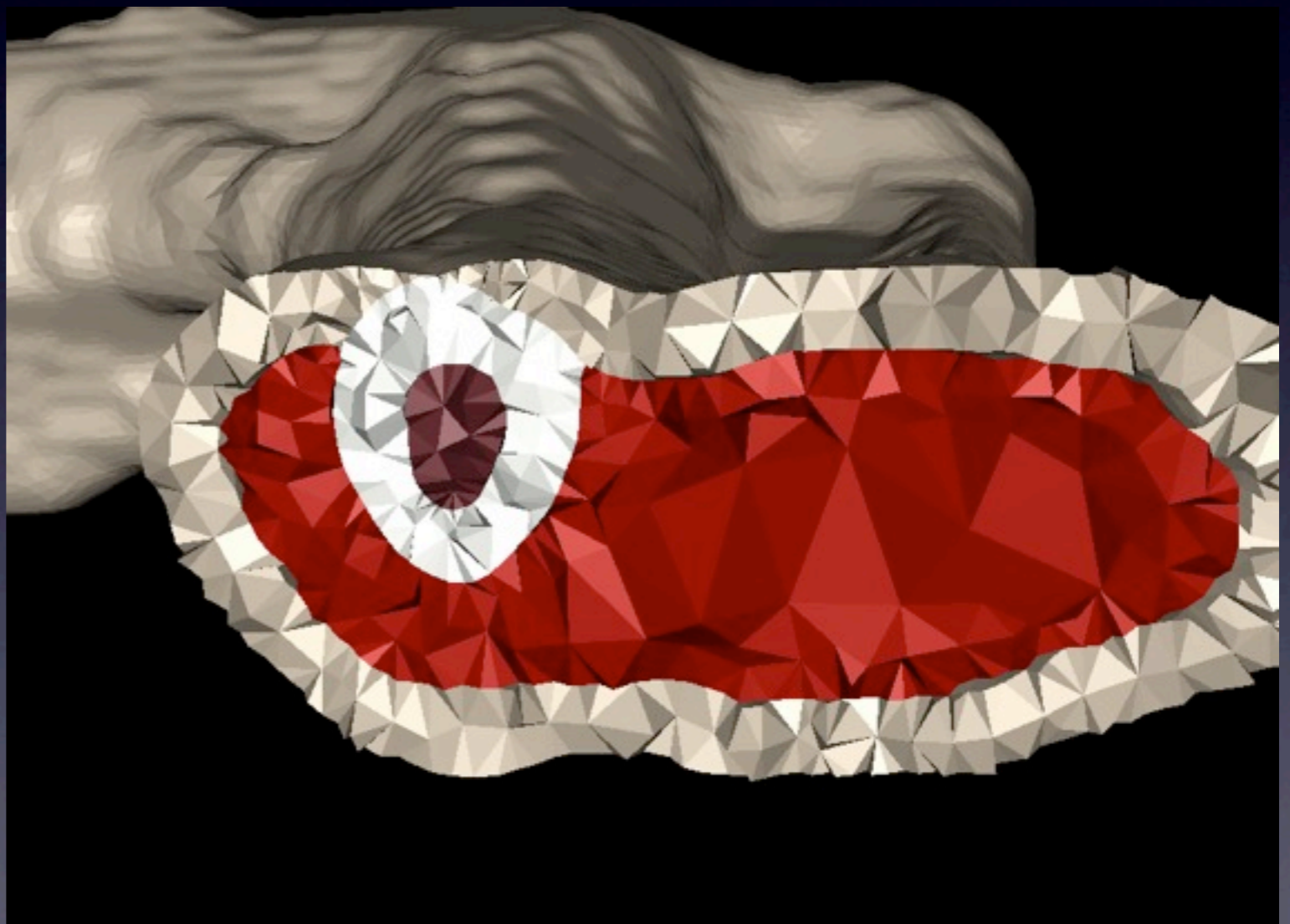
5. Seed Surface

6. Particle System

7. Generate Surfaces

8. **Generate Volume Mesh**

Tetgen for volume meshing



model_config.py

```
model_input_file="/Users/wmartin/workspace/meshing/test_utils/square/square.nrrd"
model_output_path="/Users/wmartin/workspace/meshing/test_utils/square/square-test"

mats = (0, 1)

mat_names = ('air', 'box')

mat_radii = 0.8

refinement_levels=4

max_procs=2

MAX_SIZING_FIELD = 5.0
SIZING_SCALE_VAR = 2.0

tetgen_joined_vol_flags = "pYzqA"
|
num_particle_iters = 500
```

model_config.py

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model_output_path="/Users/wmartin/workspace/meshing/test_utils/square/square-test"

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tetgen_joined_vol_flags = "pYzqA"
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num_particle_iters = 500
```

Smoothing Step - may lose thin structures

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mat_radii = 0.8

refinement_levels=4
max_procs=2

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SIZING_SCALE_VAR = 2.0

tetgen_joined_vol_flags = "pYzqA"
|
num_particle_iters = 500
```

More refinement for thin structures

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```
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model_output_path="/Users/wmartin/workspace/meshing/test_utils/square/square-test"

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mat_radii = 0.8

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SIZING_SCALE_VAR = 2.0

tetgen_joined_vol_flags = "pYzqA"
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mats = (0, 1)

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refinement_levels=4

max_procs=2

MAX_SIZING_FIELD = 5.0
SIZING_SCALE_VAR = 2.0

tetgen_joined_vol_flags = "pYzqA"
|
num_particle_iters = 500
```

Cap the sizing field
Higher number less resolution

model_config.py

```
model_input_file="/Users/wmartin/workspace/meshing/test_utils/square/square.nrrd"  
model_output_path="/Users/wmartin/workspace/meshing/test_utils/square/square-test"  
  
mats = (0, 1)  
  
mat_names = ('air', 'box')  
  
mat_radii = 0.8  
  
refinement_levels=4  
  
max_procs=2  
  
MAX_SIZING_FIELD = 5.0  
SIZING_SCALE_VAR = 2.0  
  
tetgen_joined_vol_flags = "pYzqA"  
|  
num_particle_iters = 500
```

Volume Meshing Parameters

model_config.py

```
model_input_file="/Users/wmartin/workspace/meshing/test_utils/square/square.nrrd"
model_output_path="/Users/wmartin/workspace/meshing/test_utils/square/square-test"

mats = (0, 1)

mat_names = ('air', 'box')

mat_radii = 0.8

refinement_levels=4

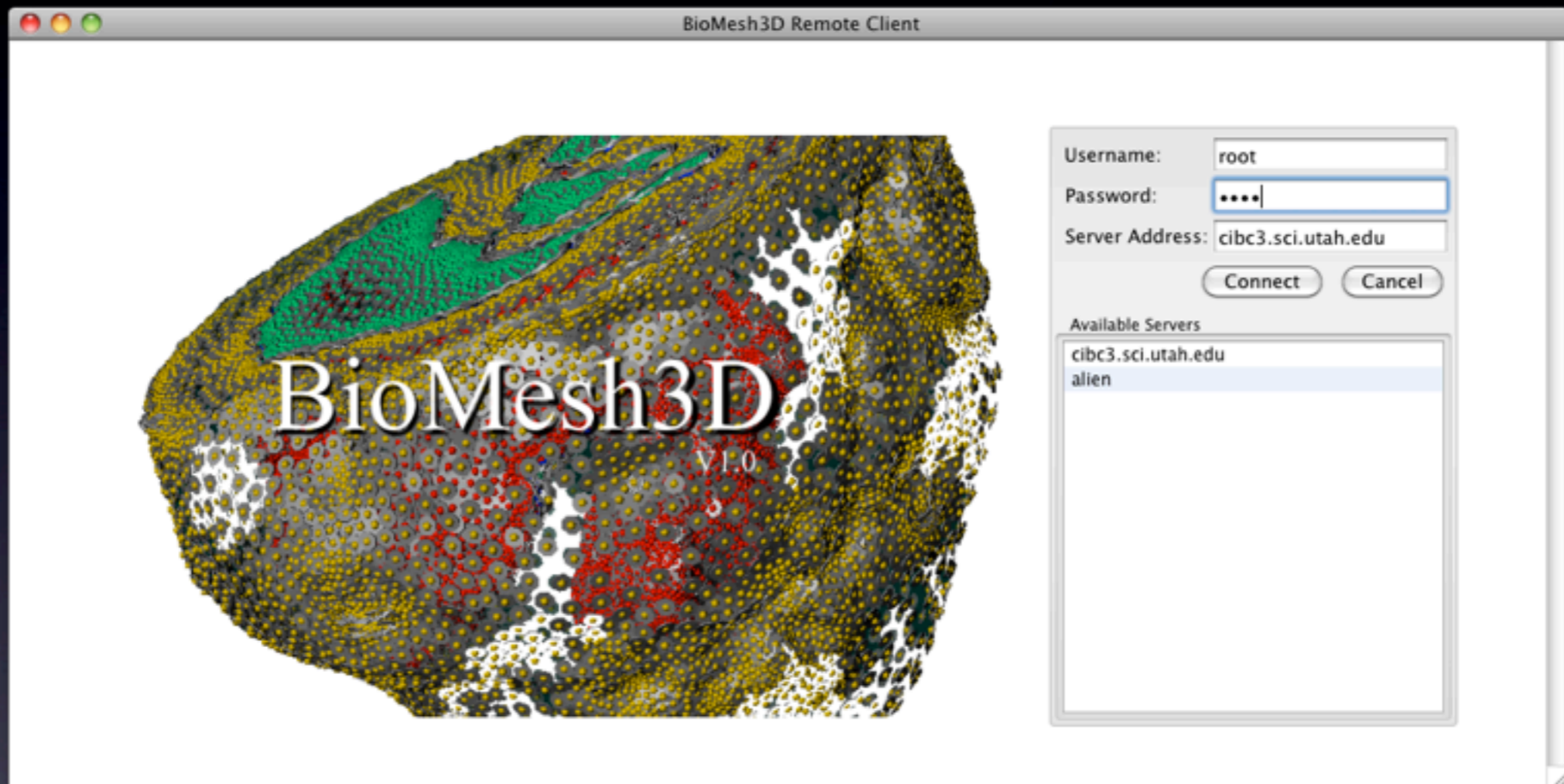
max_procs=2

MAX_SIZING_FIELD = 5.0
SIZING_SCALE_VAR = 2.0

tetgen_joined_vol_flags = "pYzqA"
|
num_particle_iters = 500
```

More iterations for better distribution

Client/Server



Mesh Configuration

The screenshot displays the BioMesh3D Remote Client interface. The window title is "BioMesh3D Remote Client - Logged in as: root". The main content area shows a list of mesh configurations:

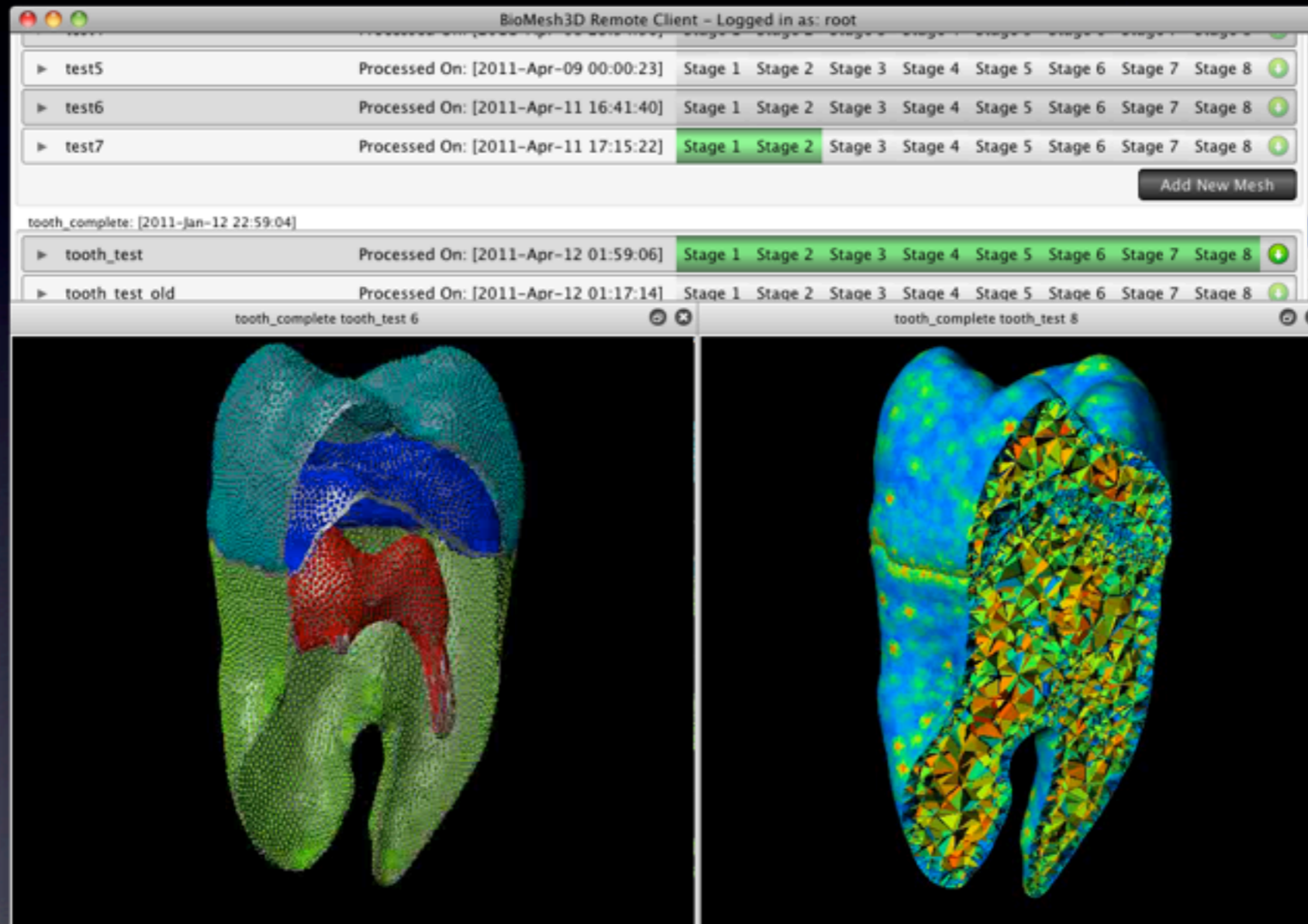
- test**: Processed On: [2011-Apr-11 21:25:37] Stage 1 Stage 2 Stage 3 Stage 4 Stage 5 Stage 6 Stage 7 Stage 8
- test2**: Processed On: [2011-Apr-11 21:28:01] Stage 1 Stage 2 Stage 3 Stage 4 Stage 5 Stage 6 Stage 7 Stage 8
- test3**: Processed On: [2011-Apr-12 00:19:11] Stage 1 Stage 2 Stage 3 Stage 4 Stage 5 Stage 6 Stage 7 Stage 8

The configuration for **test3** is expanded, showing the following settings:

- Stage 1:** A list of materials: mat0, mat1, mat2, mat3. A "Material Radius" field is set to 0.800000.
- Stage 3:** "Refinement levels" is set to 2.
- Stage 6:** "Number of iterations" is set to 100, and "Max sizing field" is set to 3.000000.
- Stage 8:** Two checkboxes are present: "Enforce min radius-edge ratio" and "Enforce max tet volume", both currently unchecked.
- Description:** A large empty text area.

At the bottom of the interface, there are several "Add New Mesh" buttons corresponding to other configurations: ATest, Another_Tooth, Sphere_Test, and Tooth.

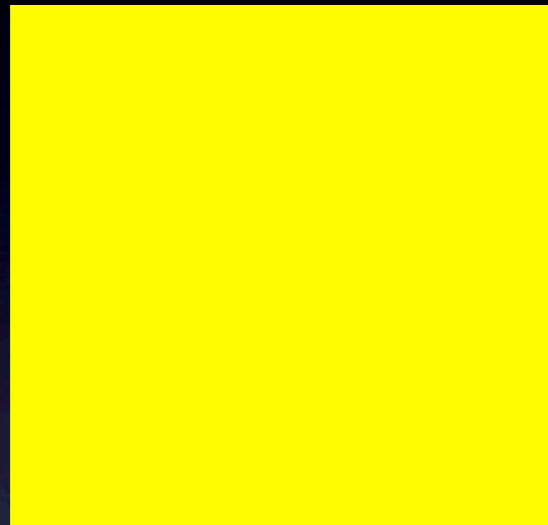
Visualizing Stages



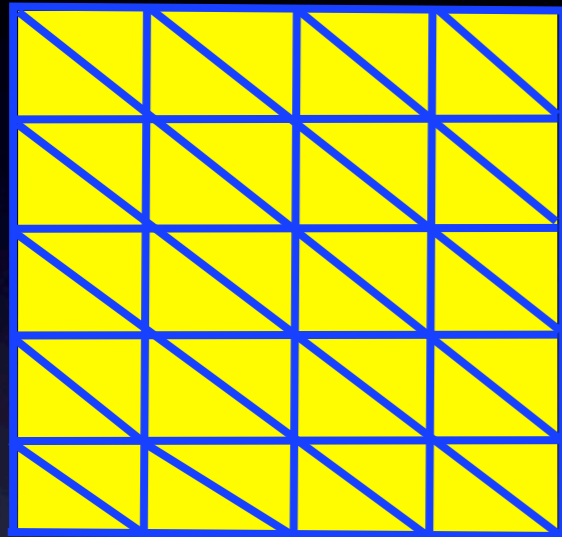
Demo



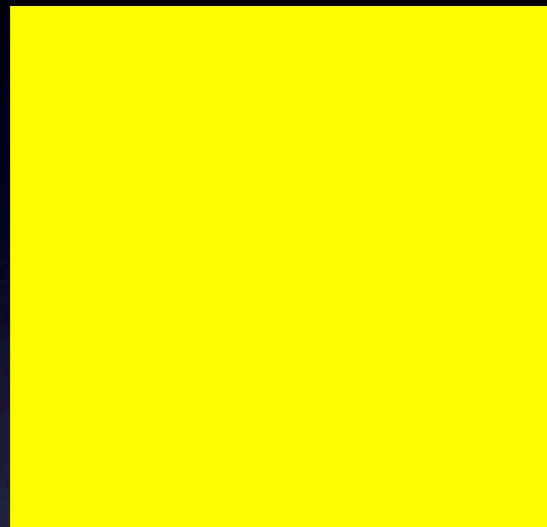
Meshing In Biology



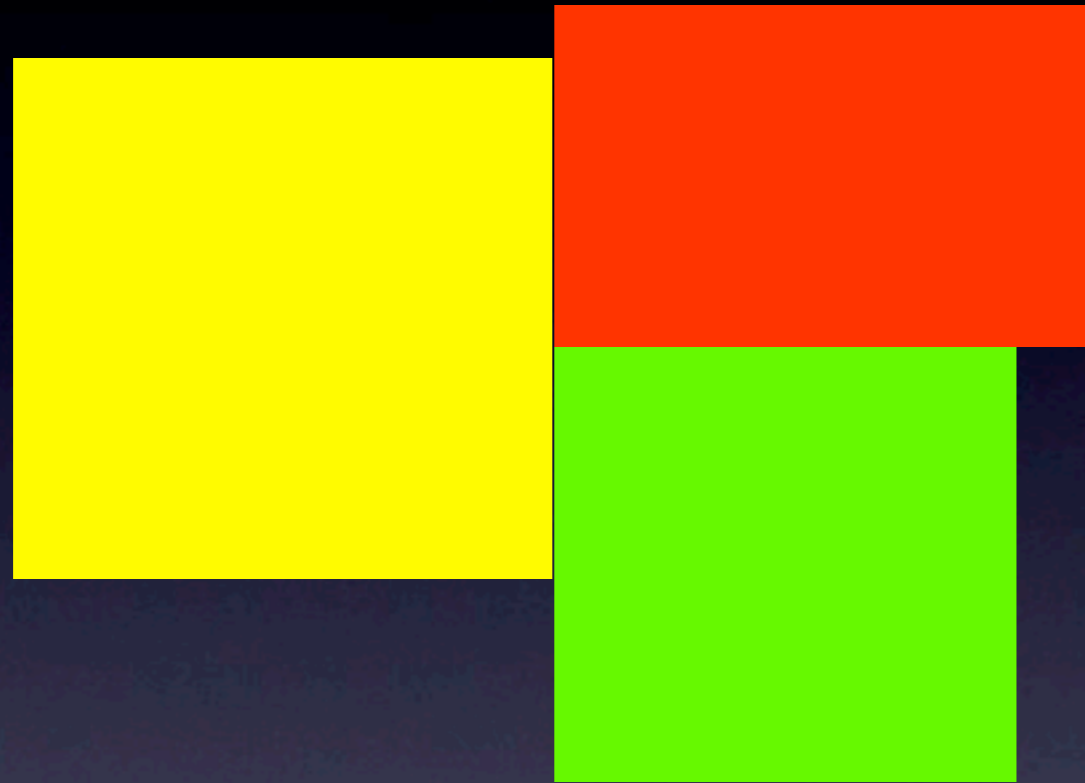
Meshing In Biology



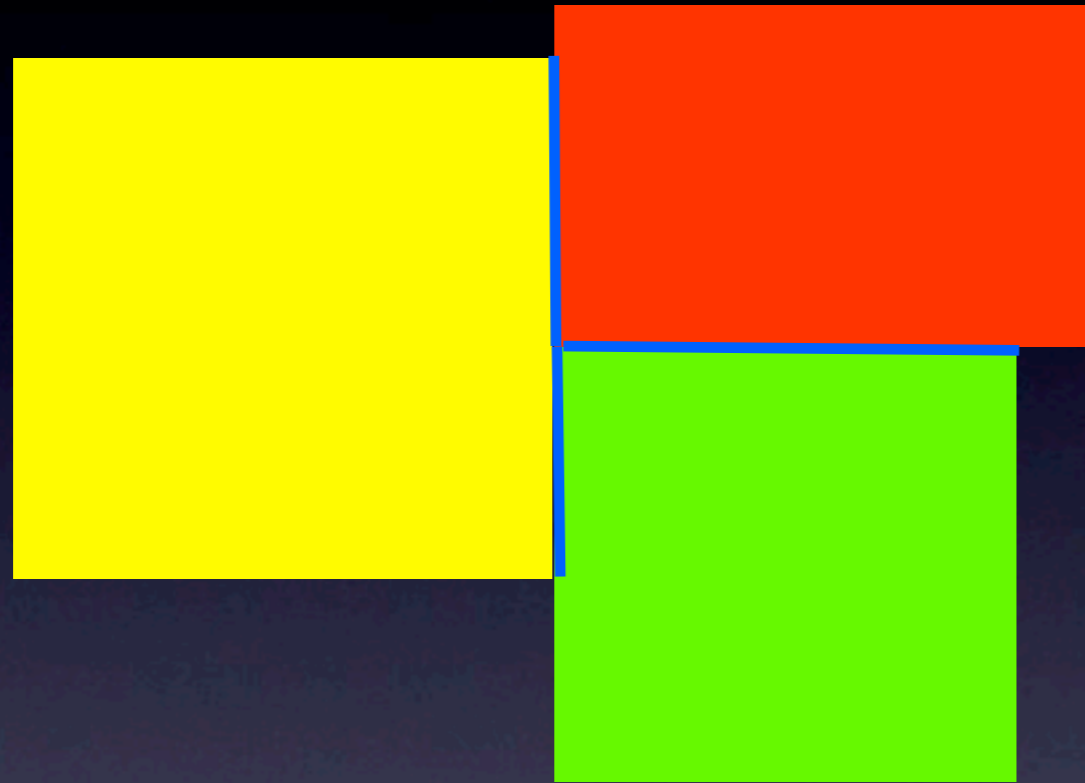
Meshing In Biology



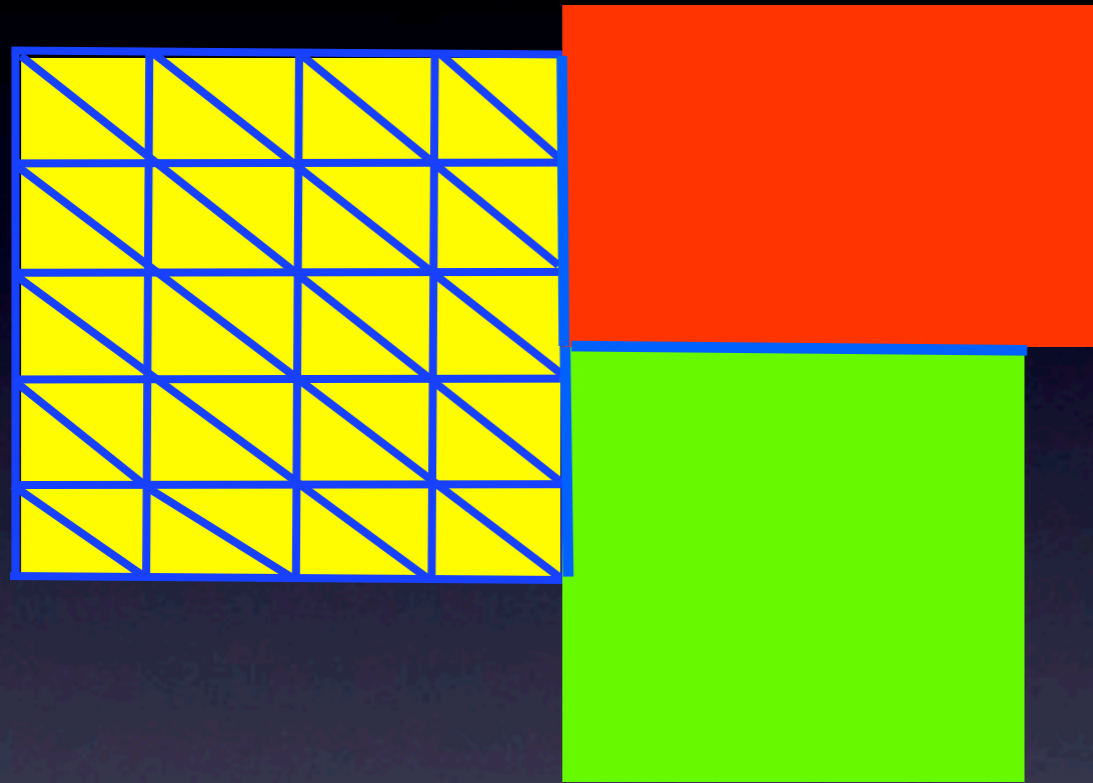
Meshing In Biology



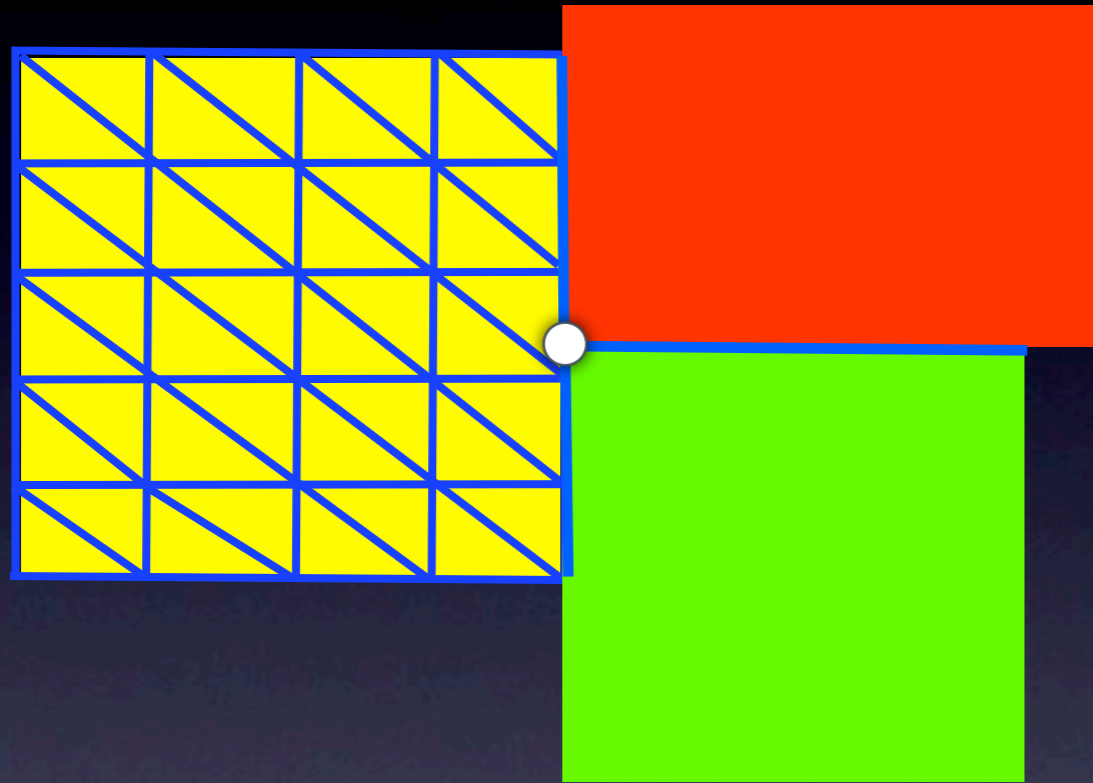
Meshing In Biology



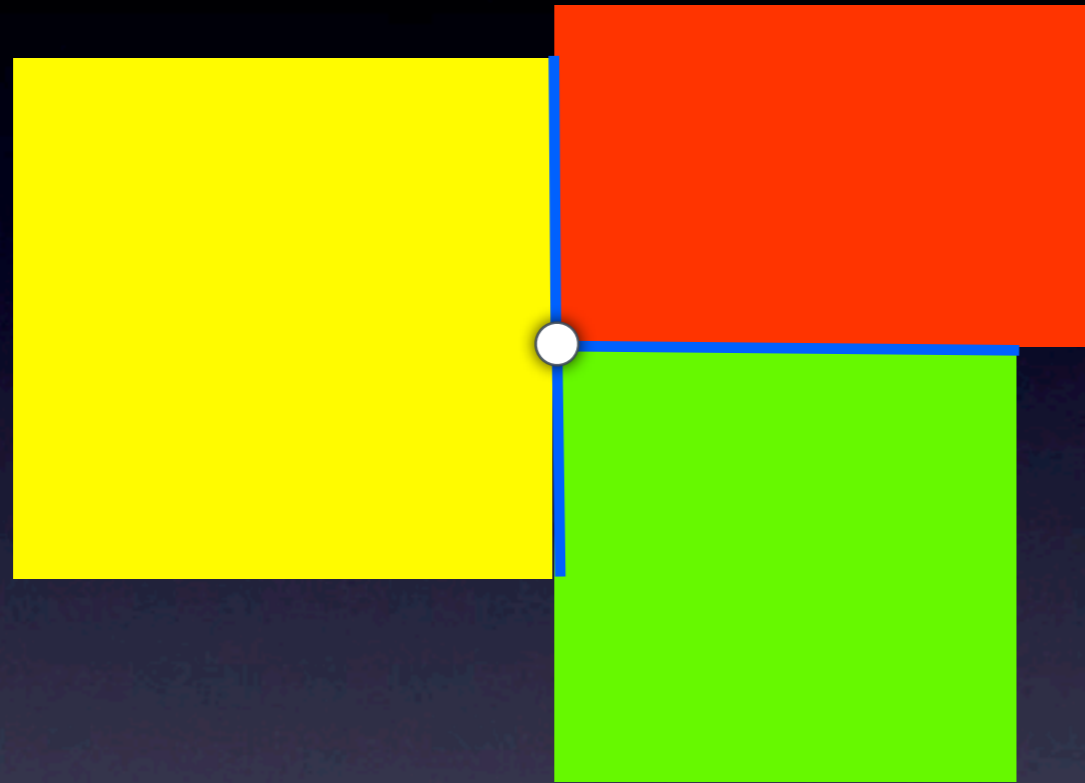
Meshing In Biology



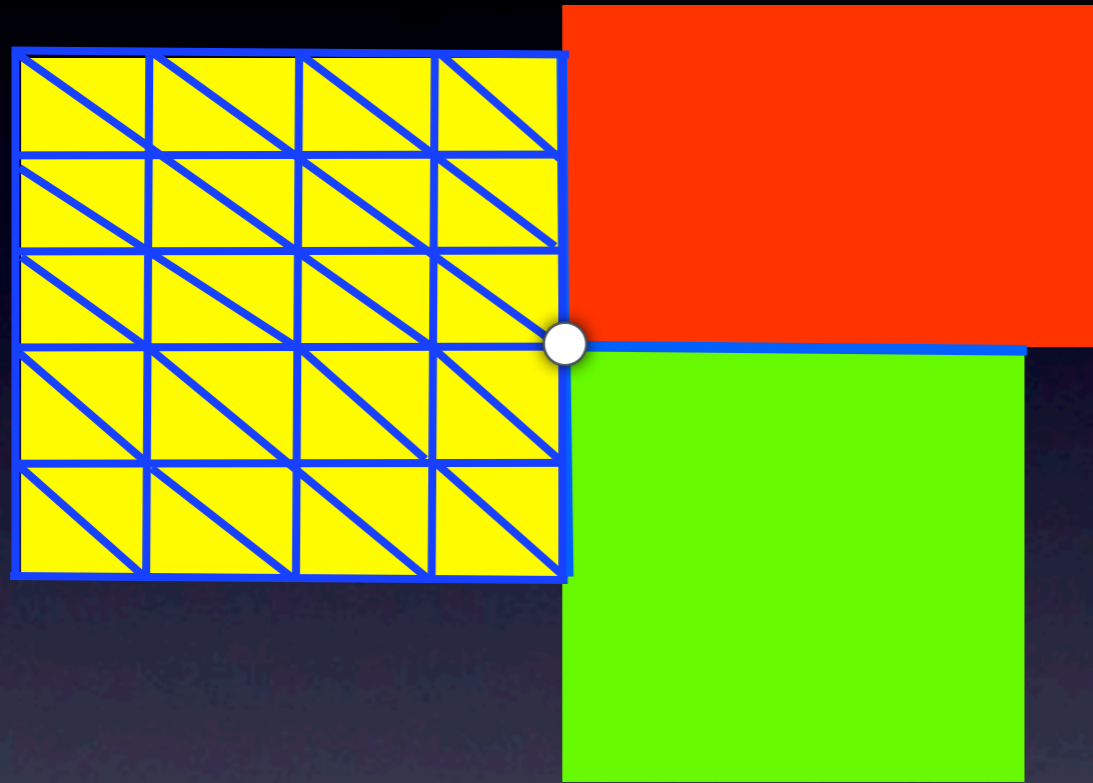
Meshing In Biology



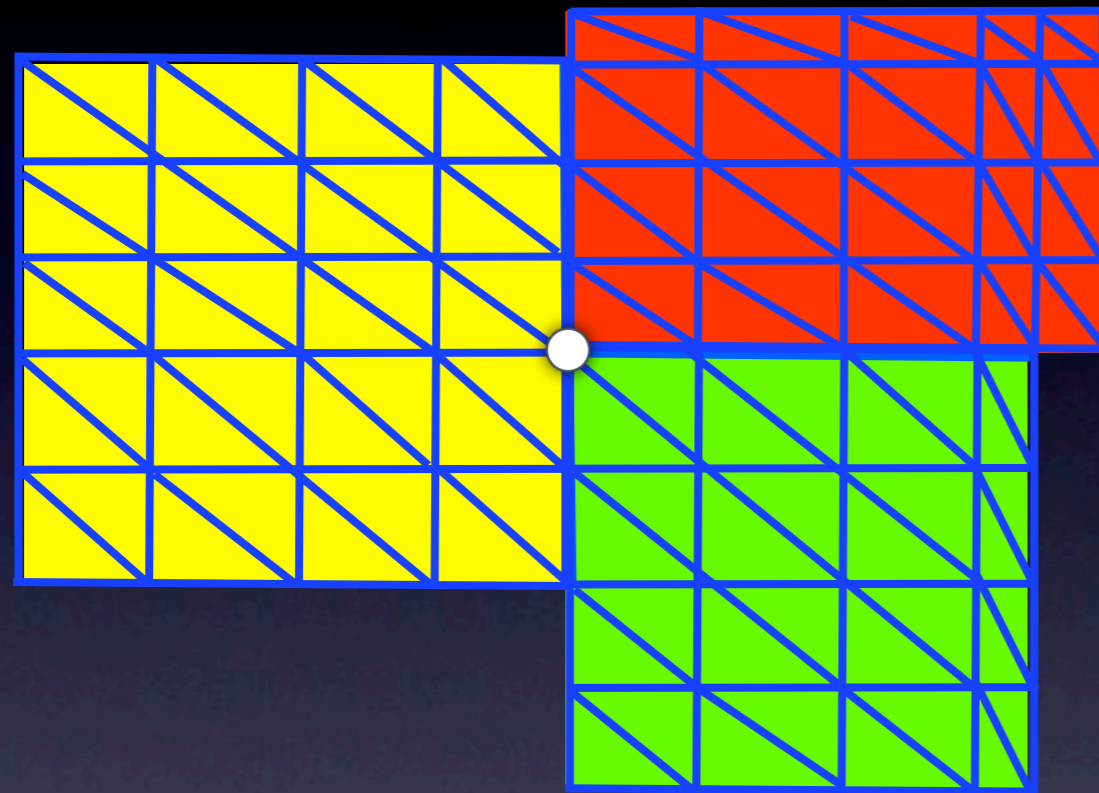
Meshing In Biology



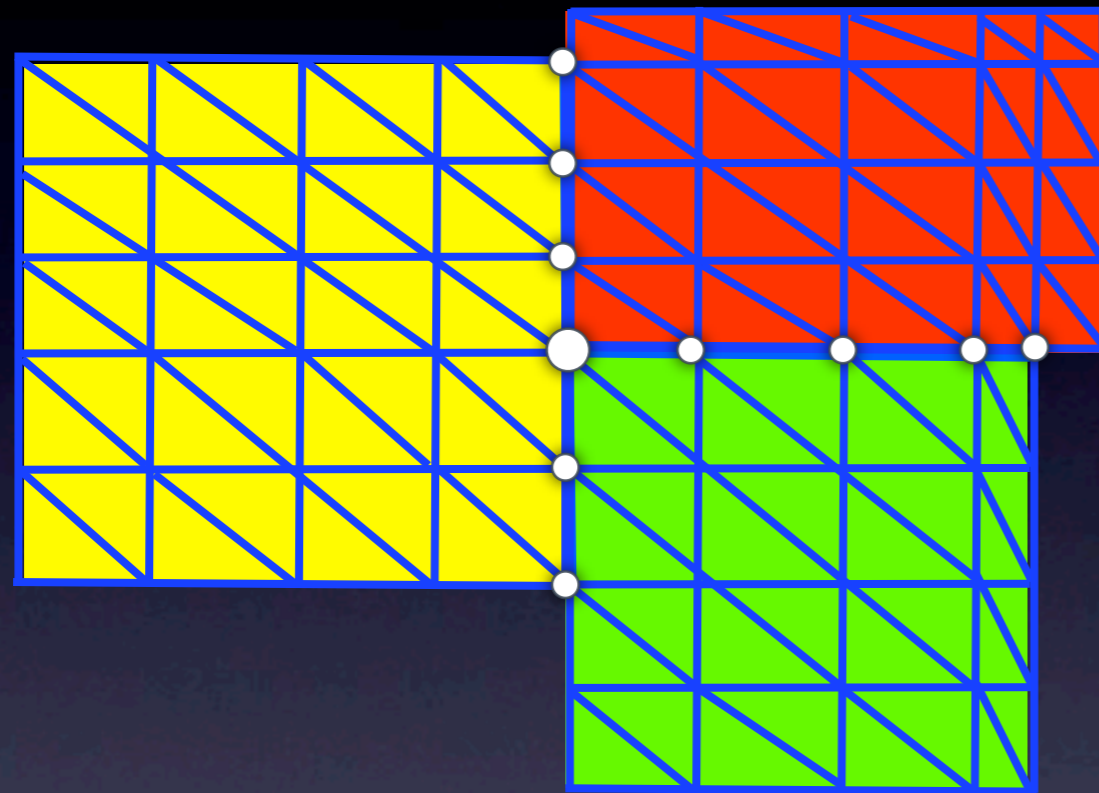
Meshing In Biology



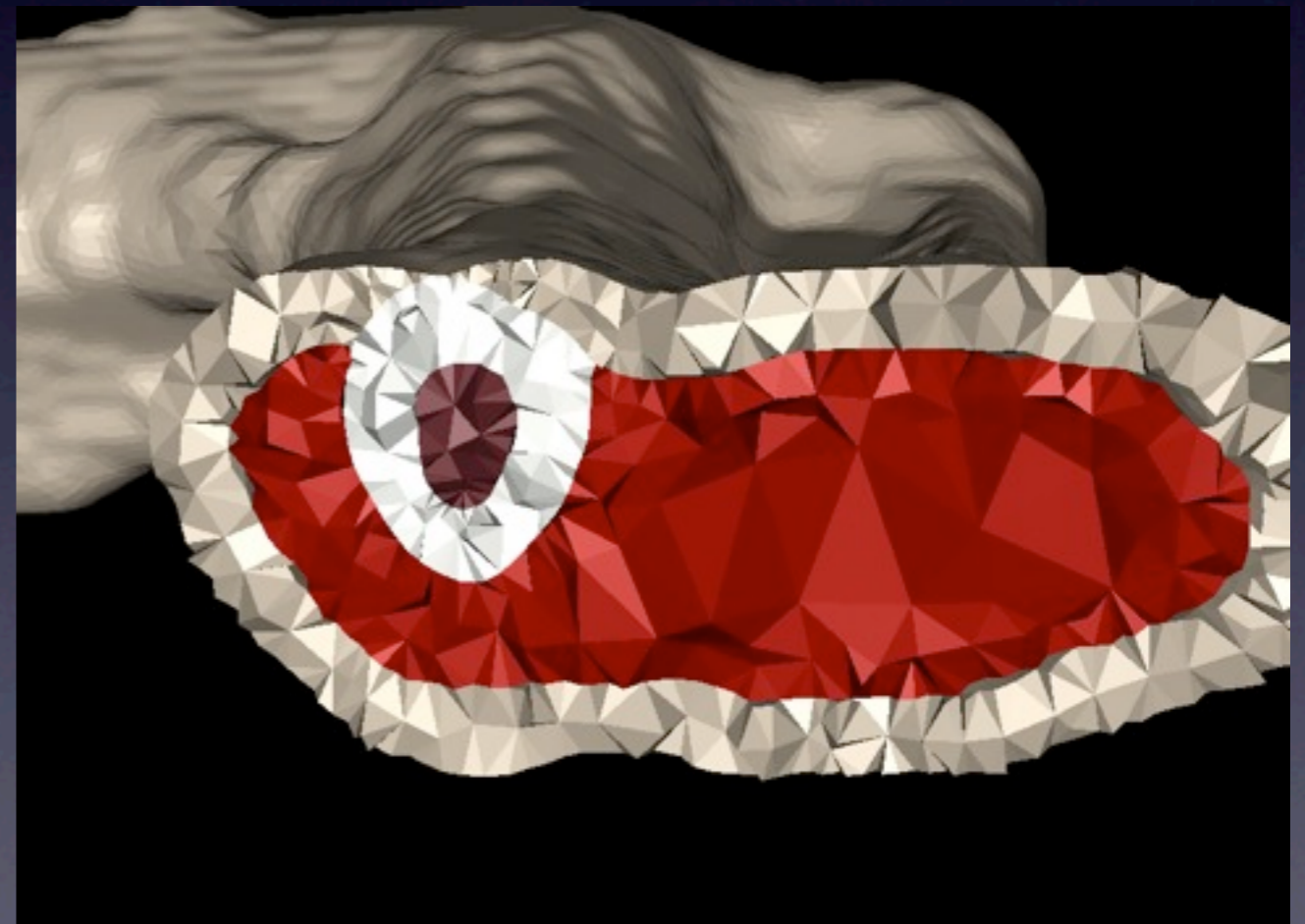
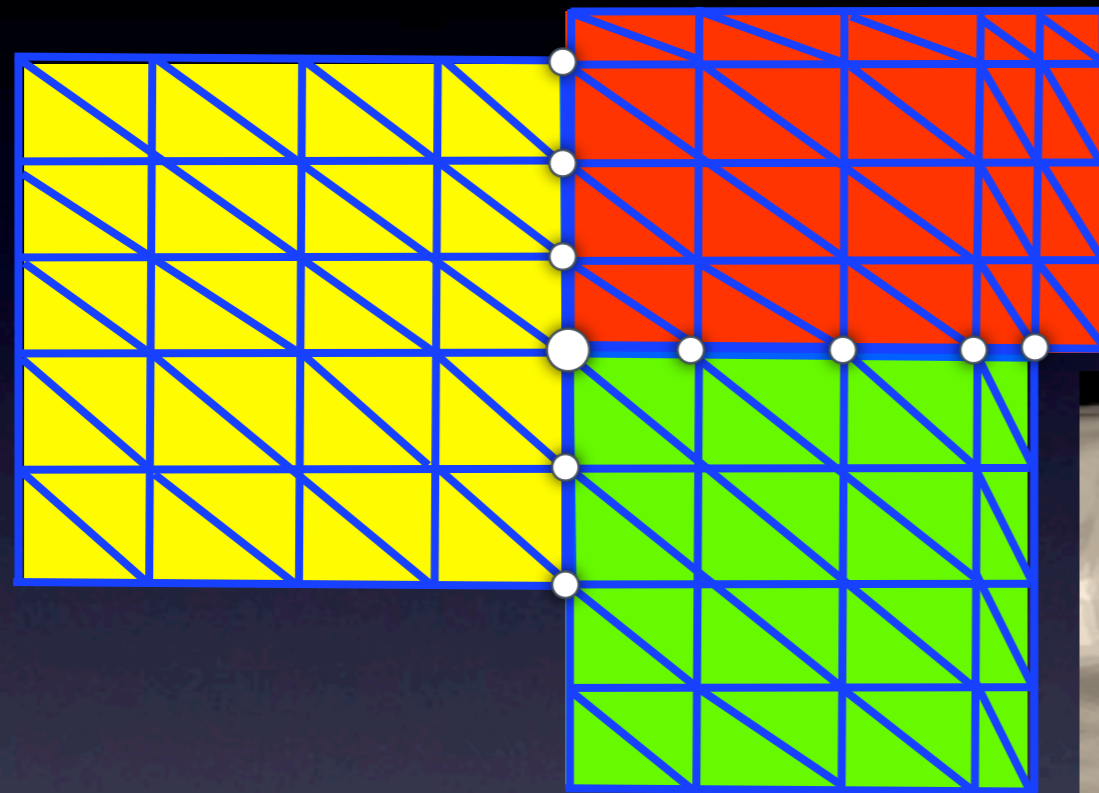
Meshing In Biology



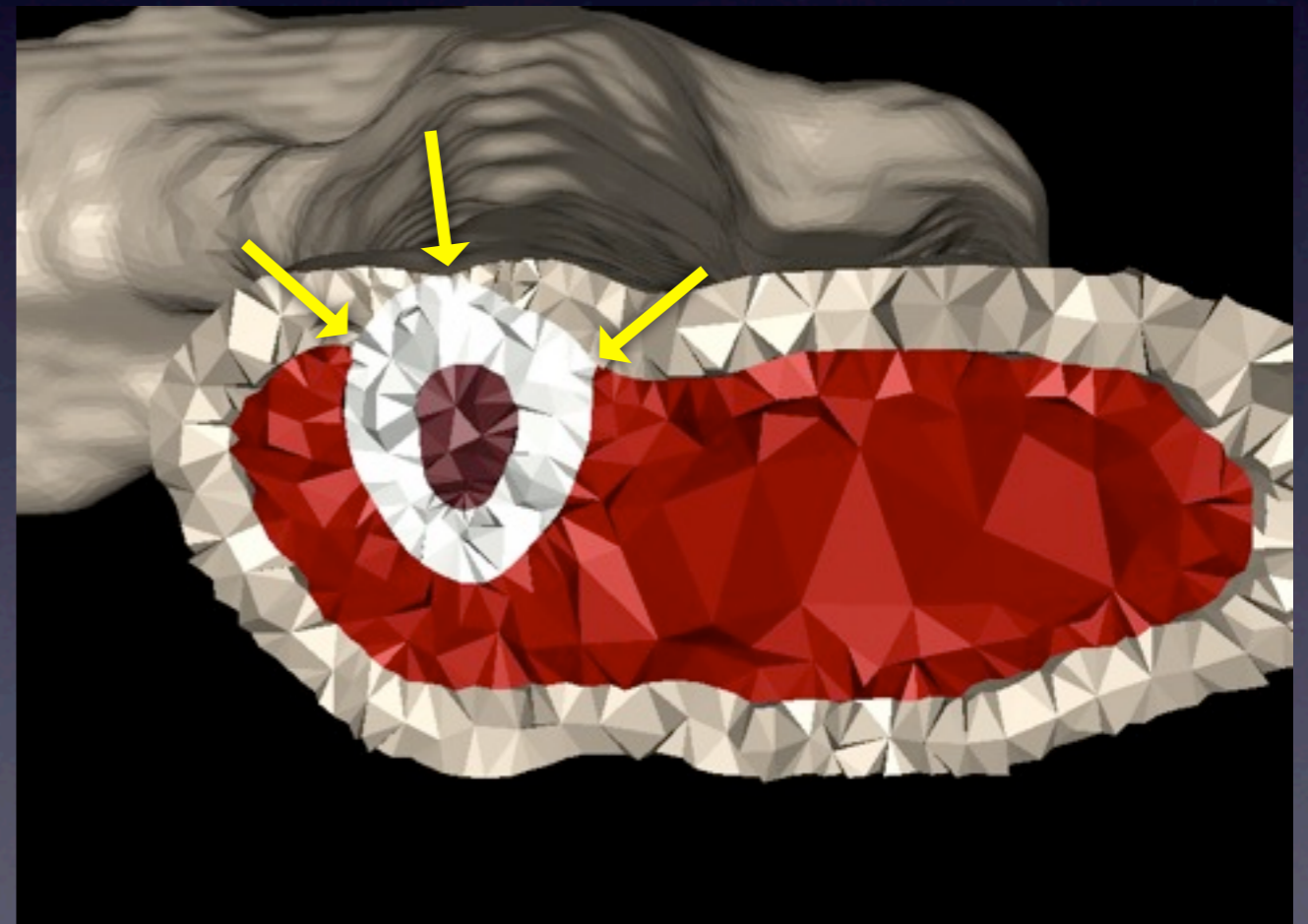
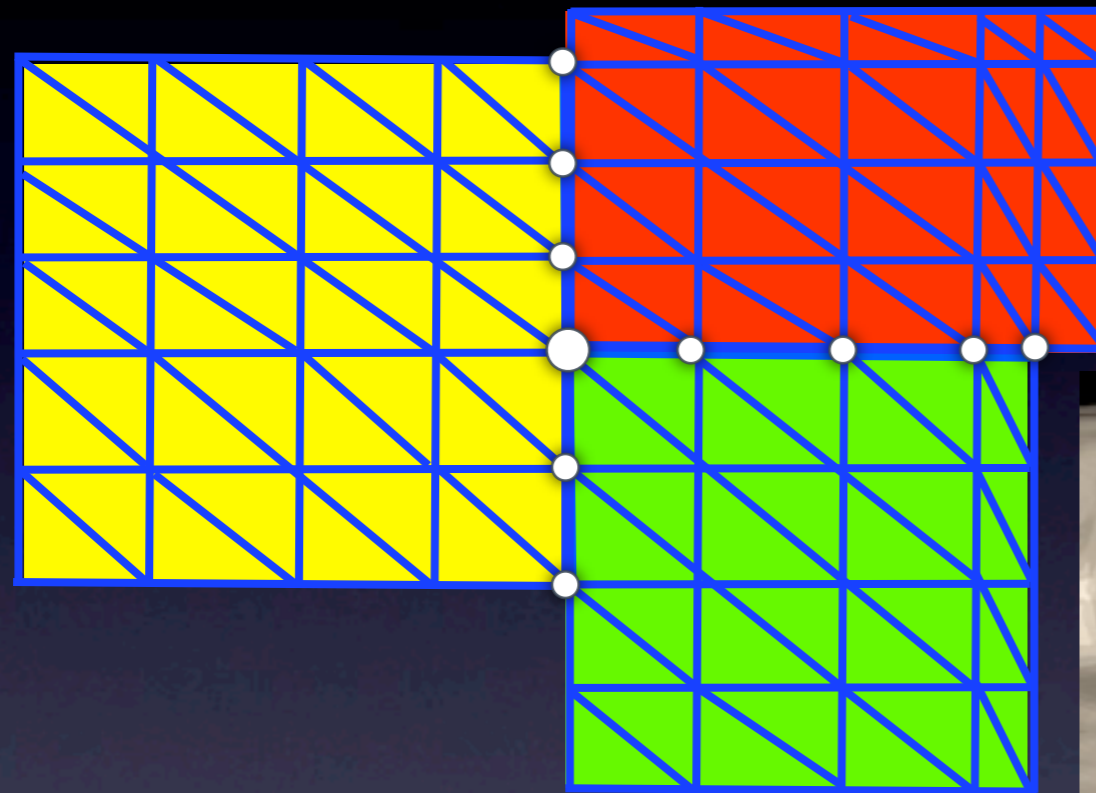
Meshing In Biology



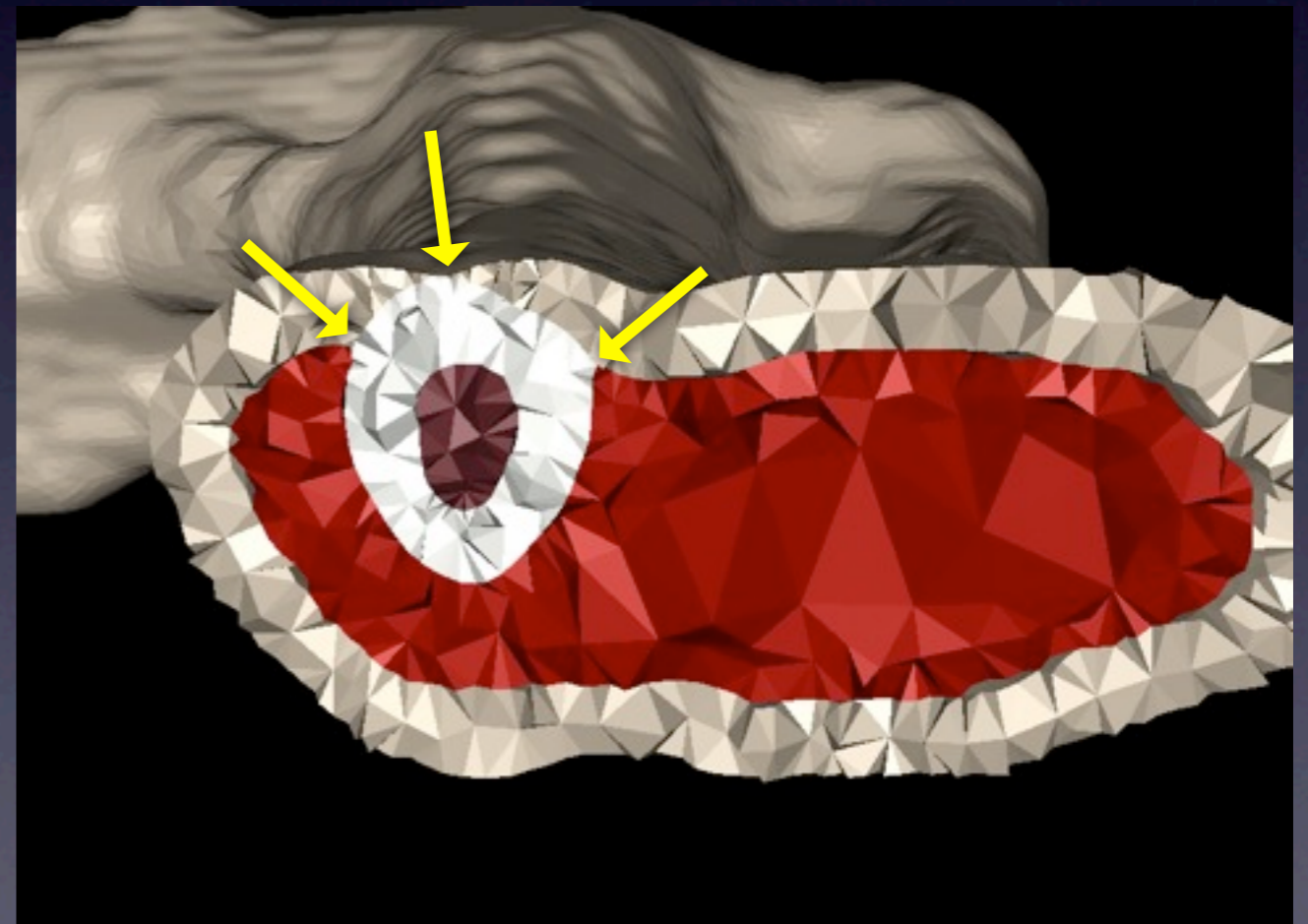
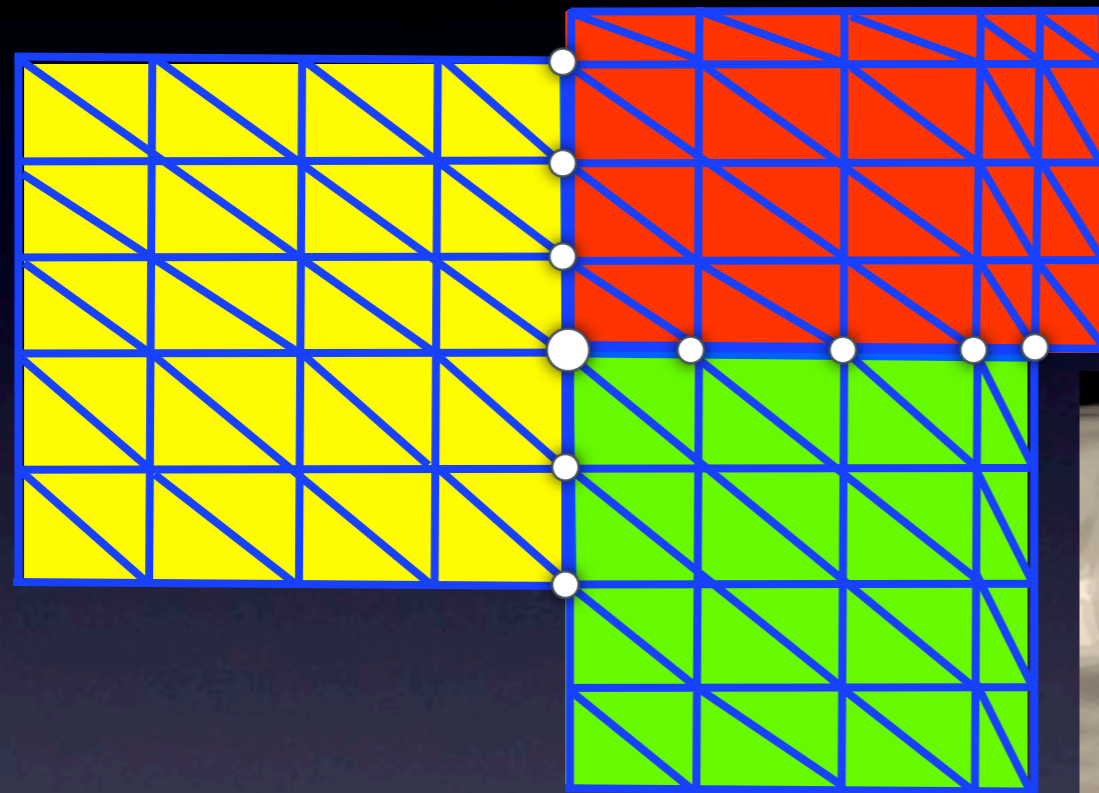
Meshing In Biology



Meshing In Biology

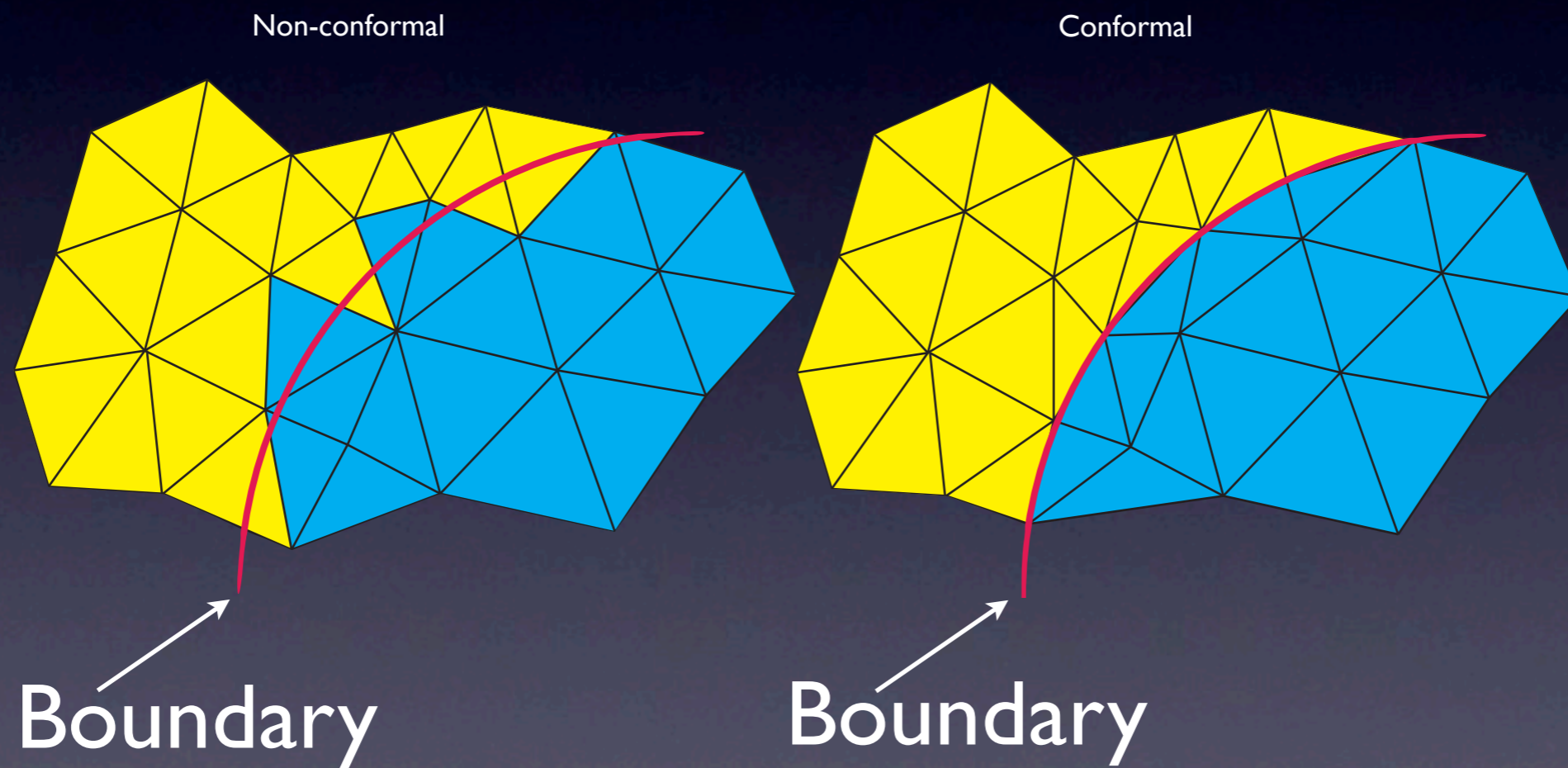


Meshing In Biology



Biomech3D
CGAL
DeIPSC

Non-Conformal vs Conformal



Non-Conformal vs Conformal

Replicated
Boundary

Non-conformal

Conformal

