Common coordinate scaffolds for mapping and modeling organs
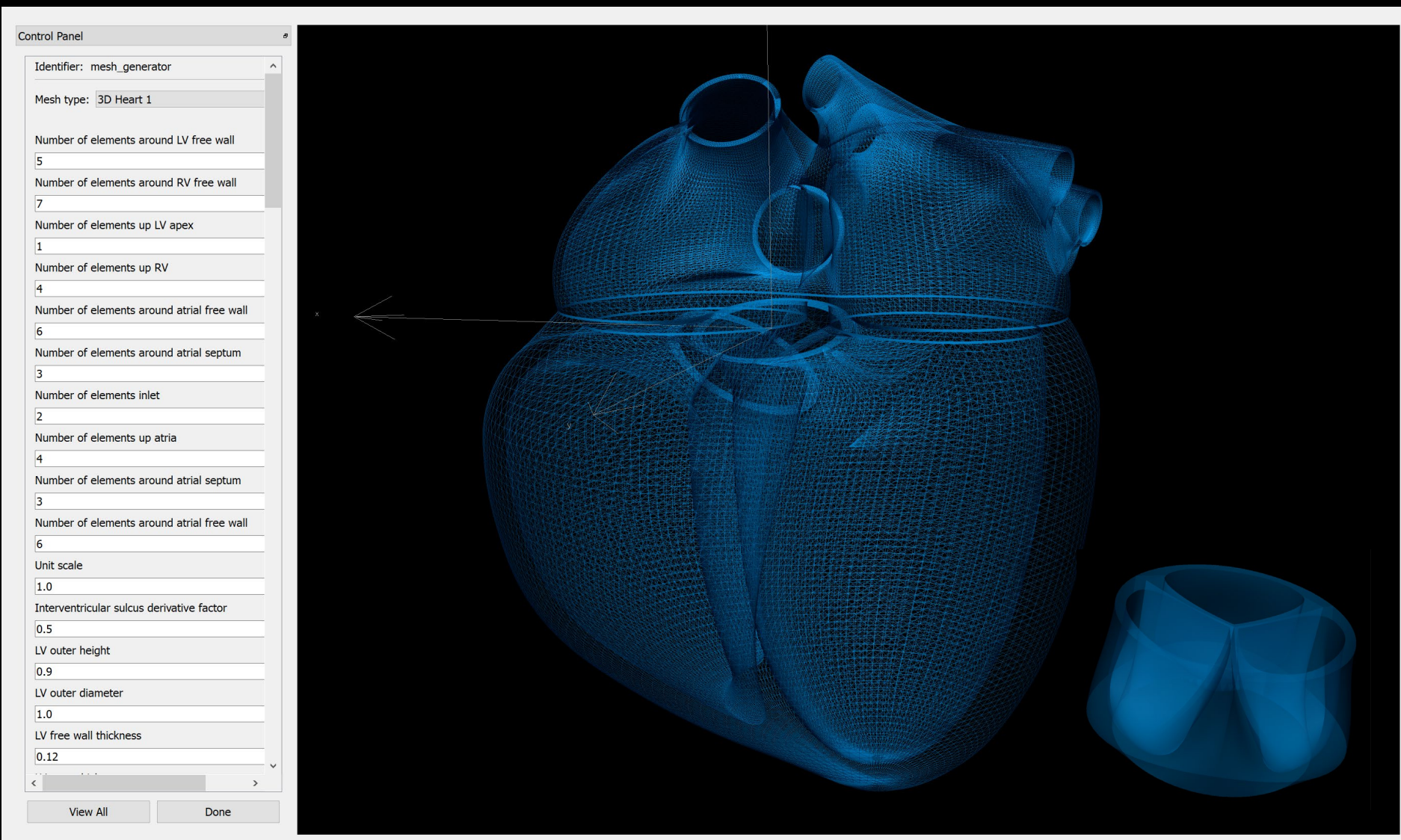
Peter Hunter

THE UNIVERSITY OF AUCKLAND
Te Whare Wānanga o Tāmaki Makaurau
NEW ZEALAND
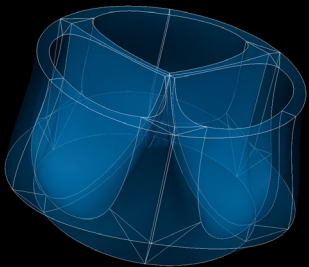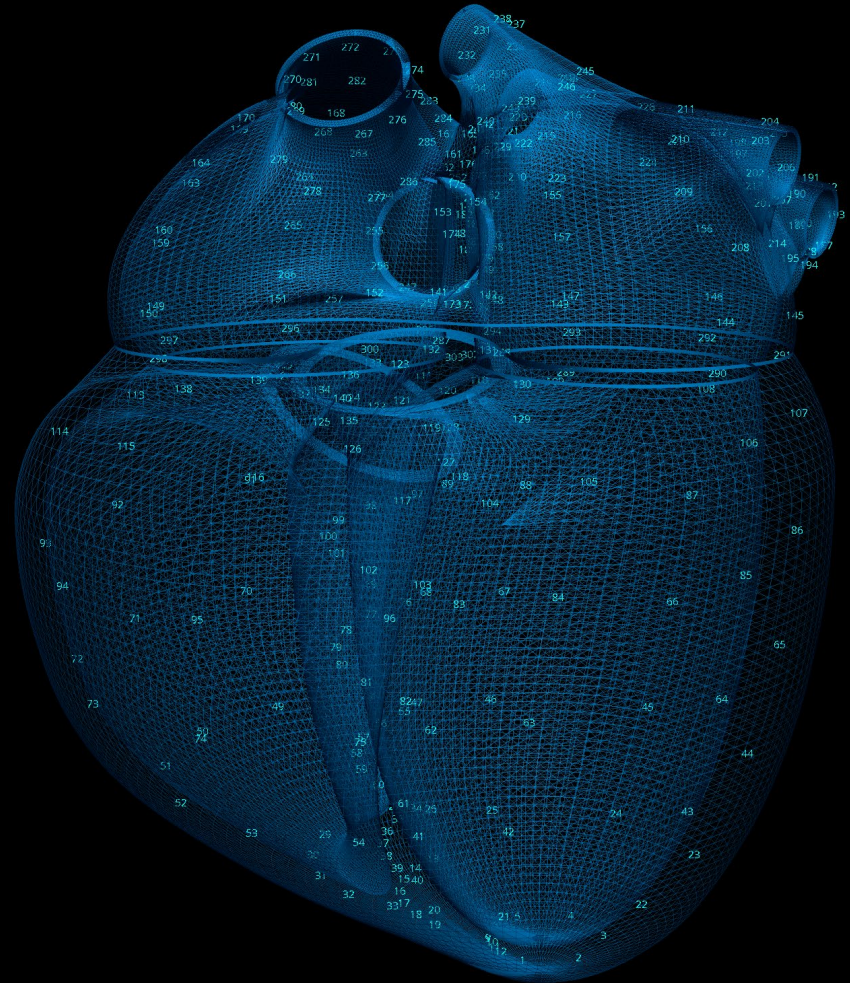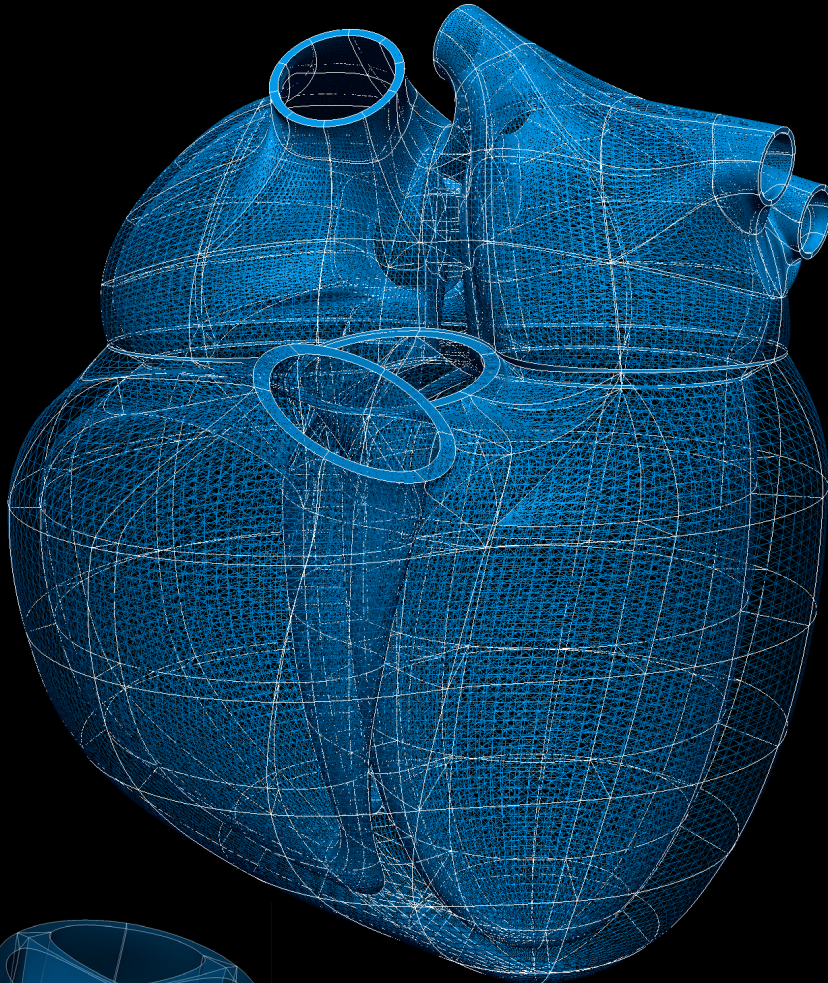
AUCKLAND BIOENGINEERING INSTITUTE
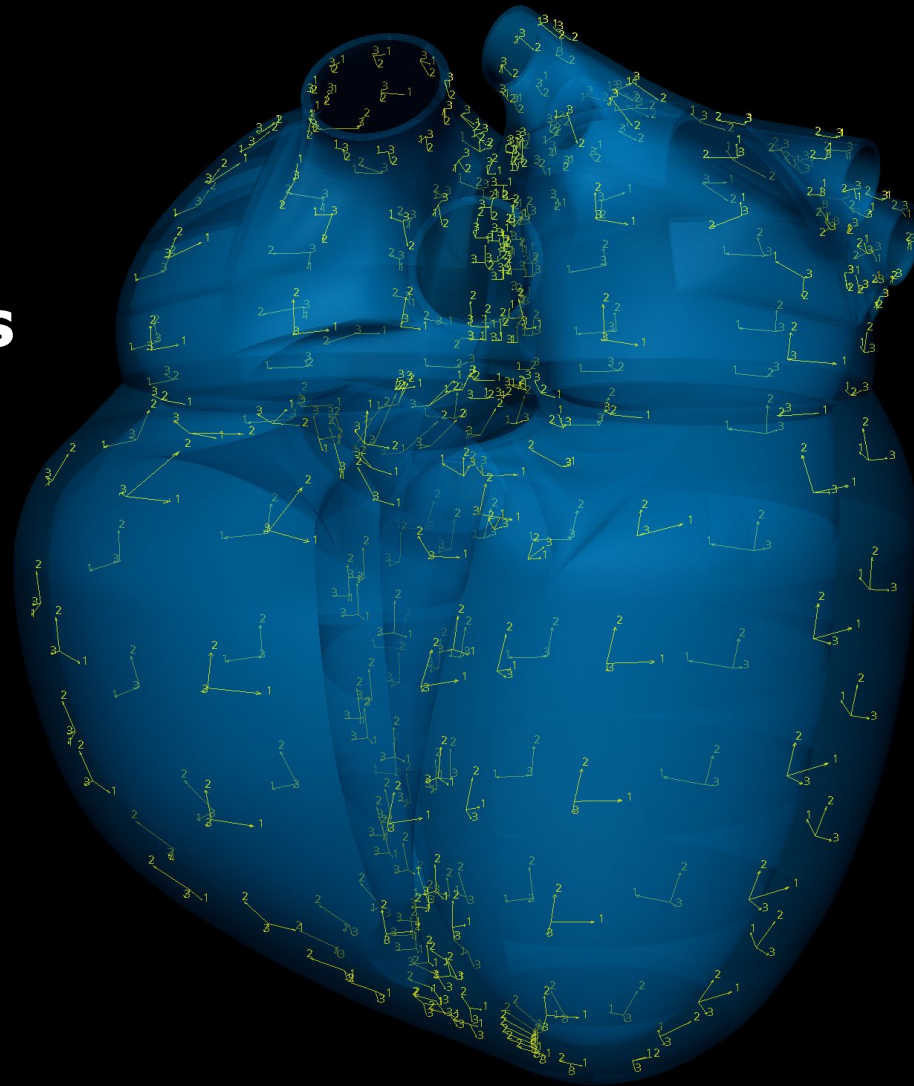
1. **Heart scaffold**

2. **Stomach scaffold**
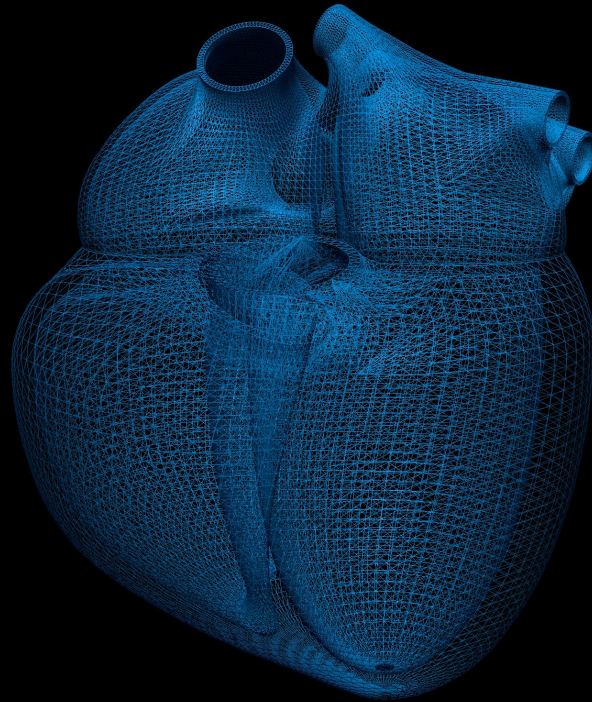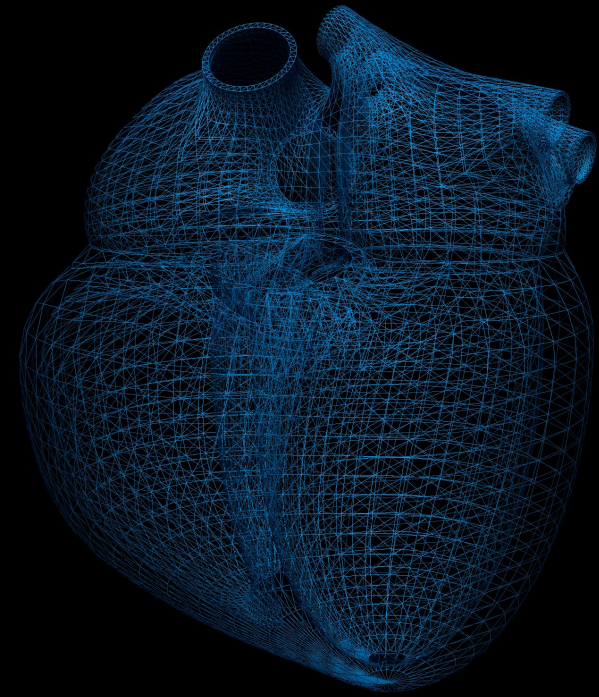
A biological CAD platform:
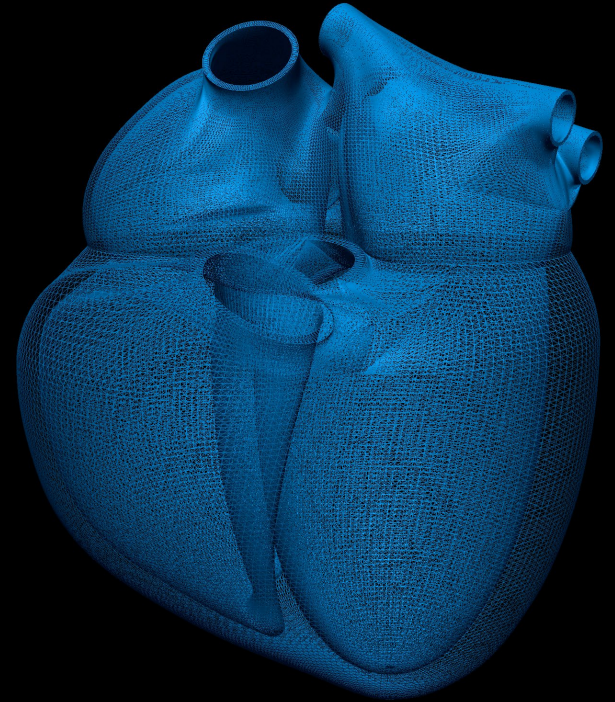# Heart scaffold

Tricubic Hermite Elements establish the material coords

Material axes

Exporting meshes for simulation

2x refinement

4x refinement

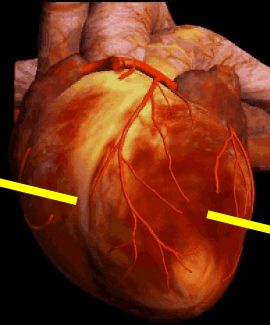# Species dependent scaffolds

Generic scaffold

incorporates ..

Tissue structure

Vasculature

Intracardiac neurons

for species 1

.. species 2

.. species 3

+ individual variability
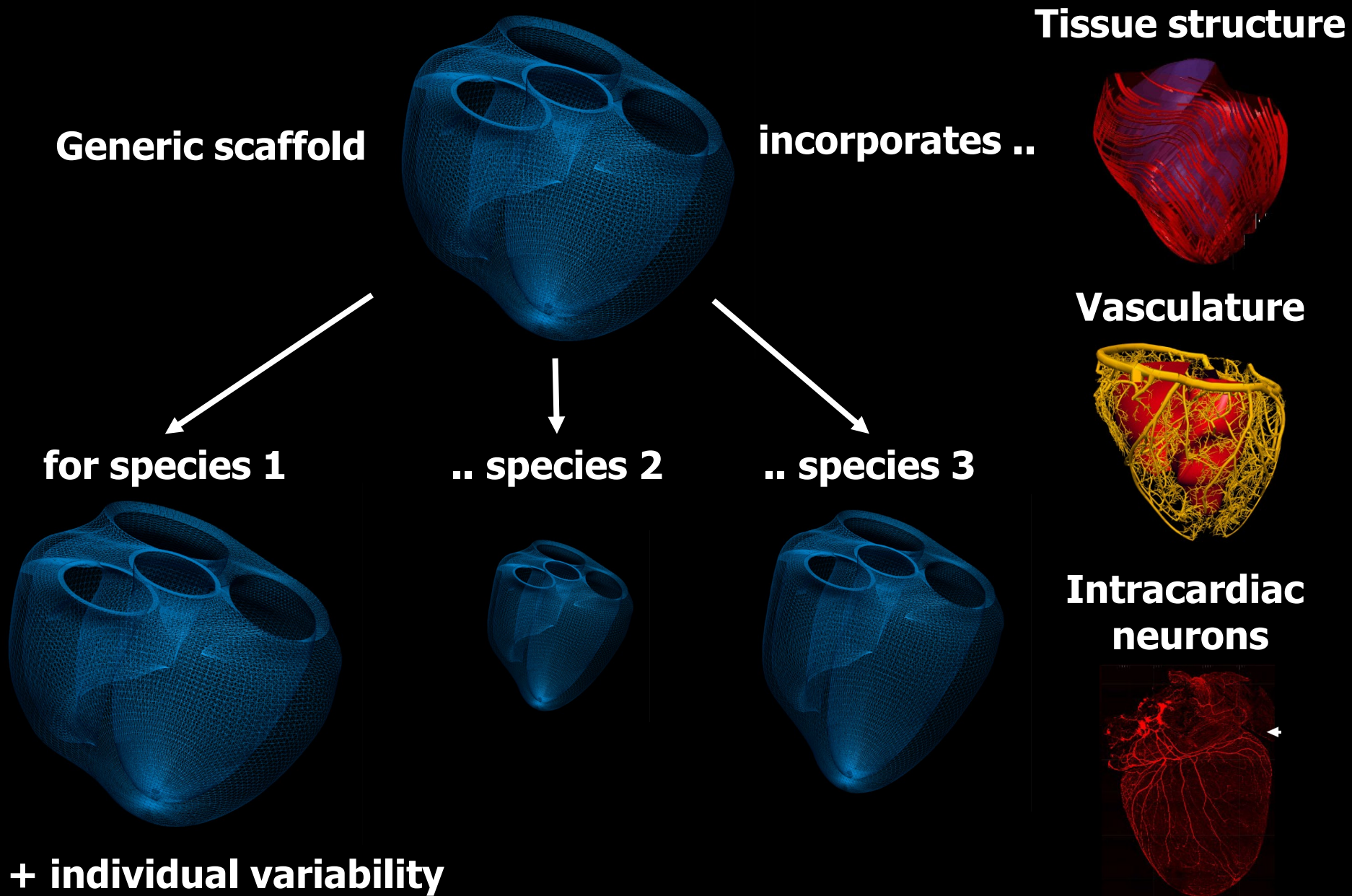
The heart physiome

torso

heart

tissue

$$m = 10^9 nm$$

cellular processes

cell-cell connections

amino acid sequence

3D cell

proteins

genomic sequence

nm

©2005 Structural Imaging : Bioengineering Institute : The University of Auckland
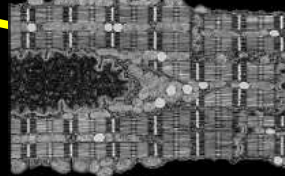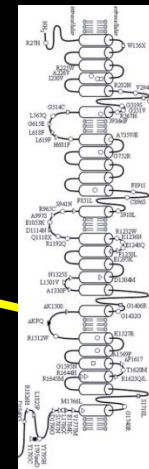
Molecular scale
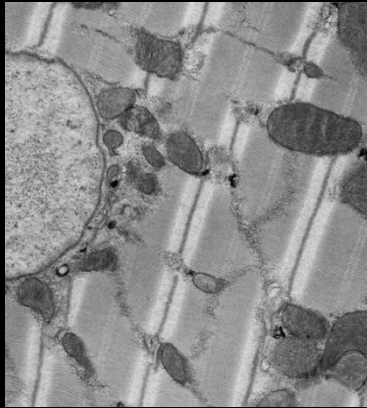
2μm

Cellular scale

100μm

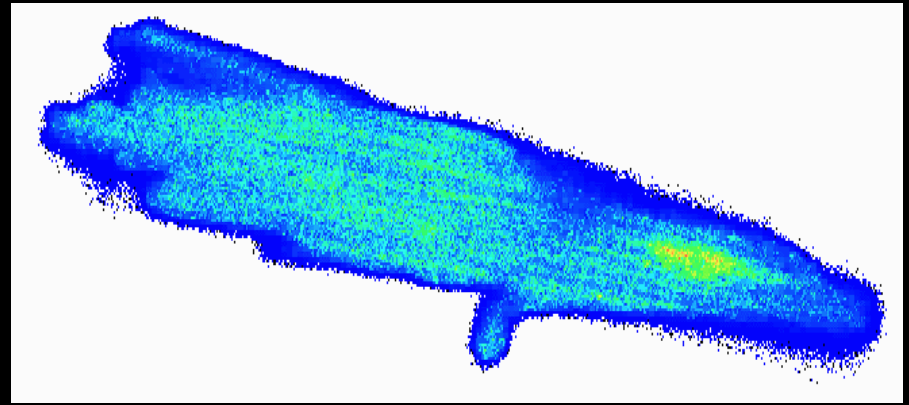**Tissue/organ scale**
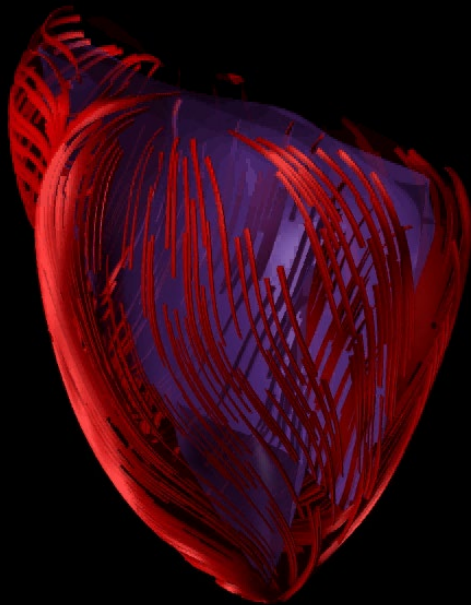
10mm
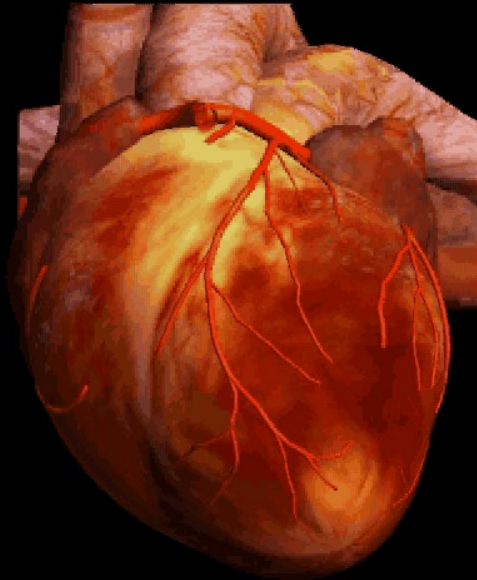
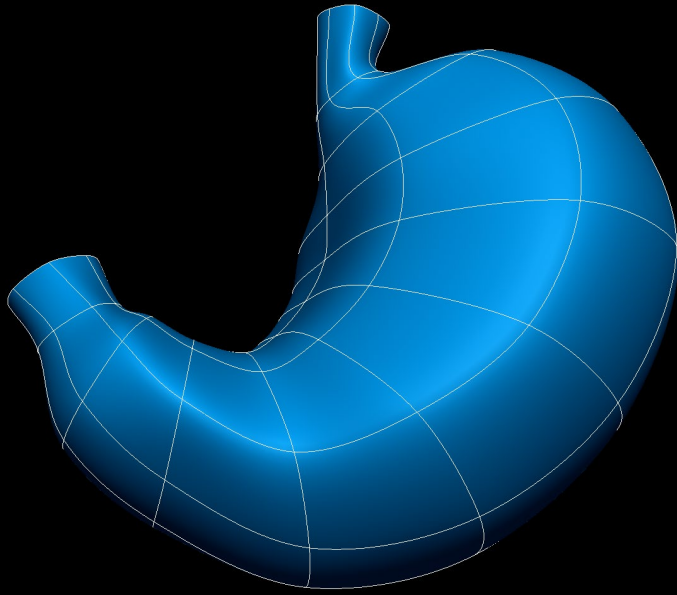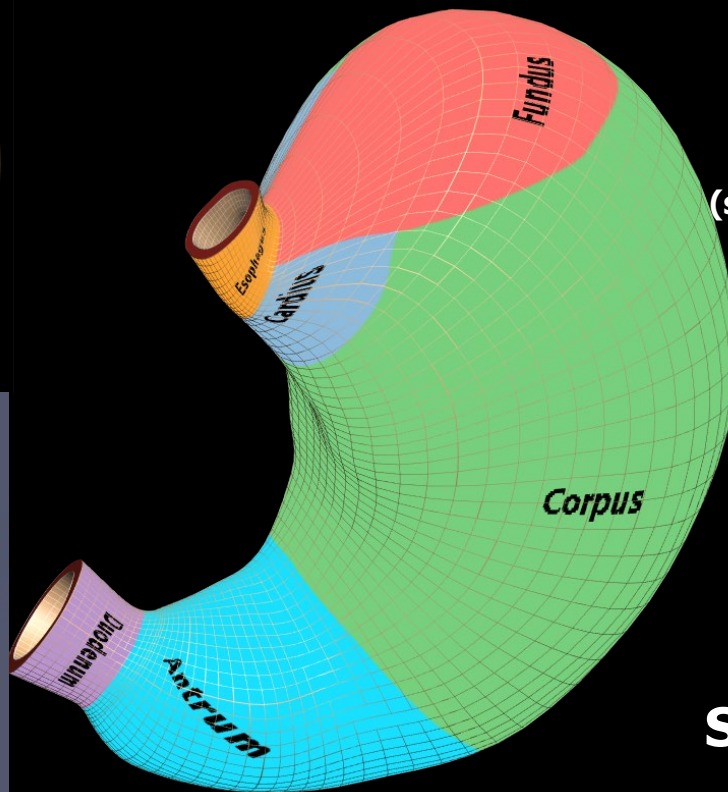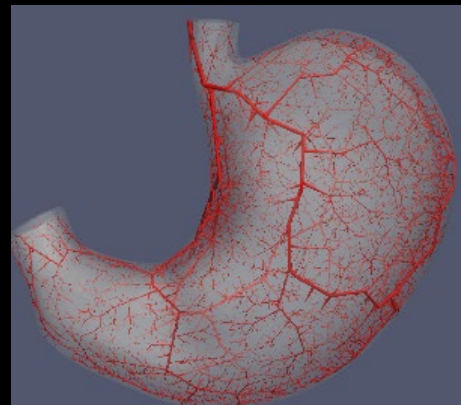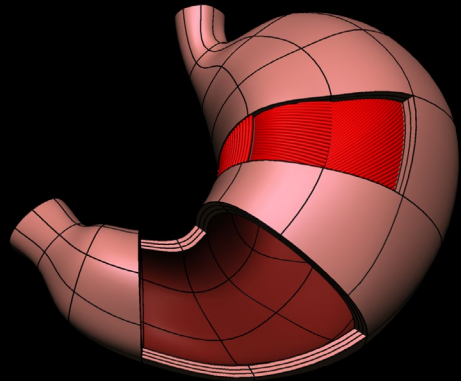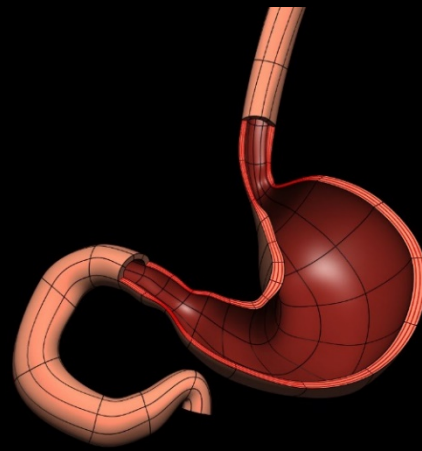**Clinical scale**
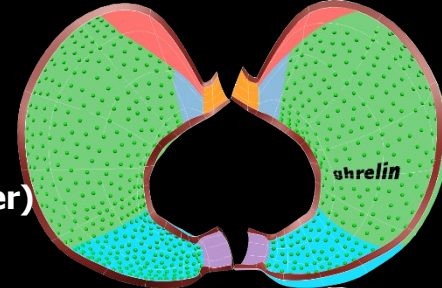
1. Heart scaffold

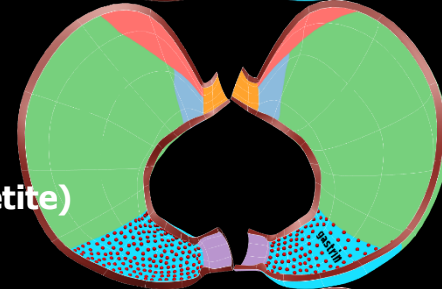2. **Stomach scaffold**

Stomach scaffold
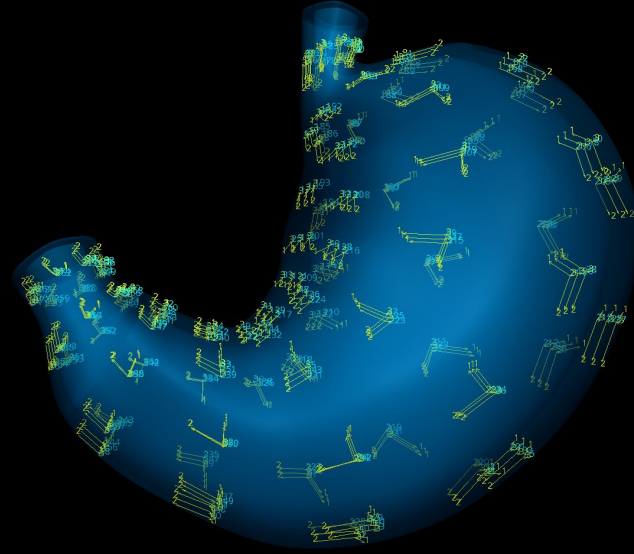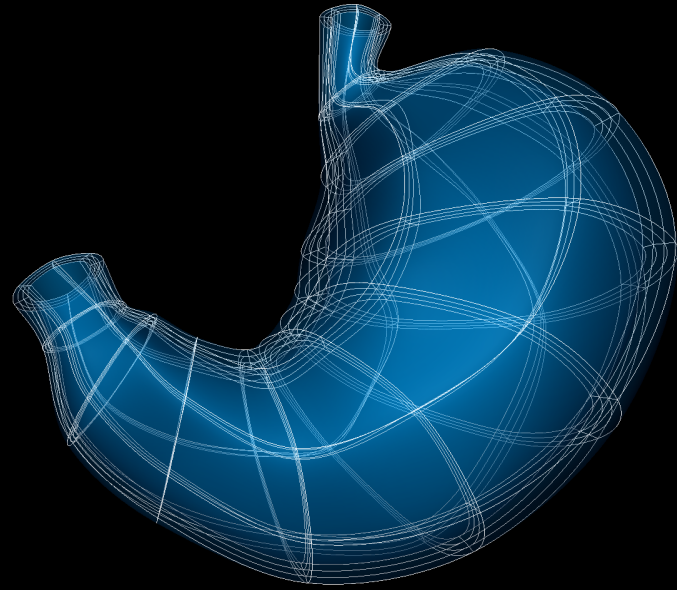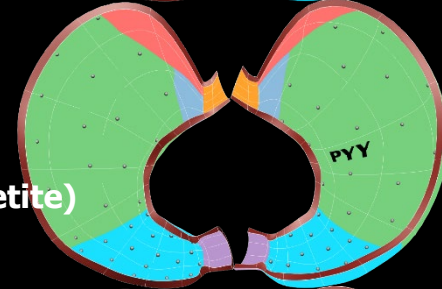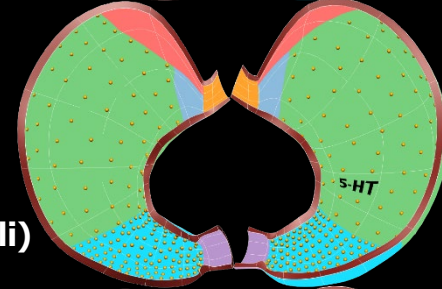
Structure & function in the stomach

Ghrelin
(signals hunger)

Gastrin
(stimulates appetite)

PYY
(suppresses appetite)

5-HT
(responds to noxious stimuli)

Somatostatin
(pH control)

Fundus

Esophagus

Cardius

Corpus

Duodenum

Antrum

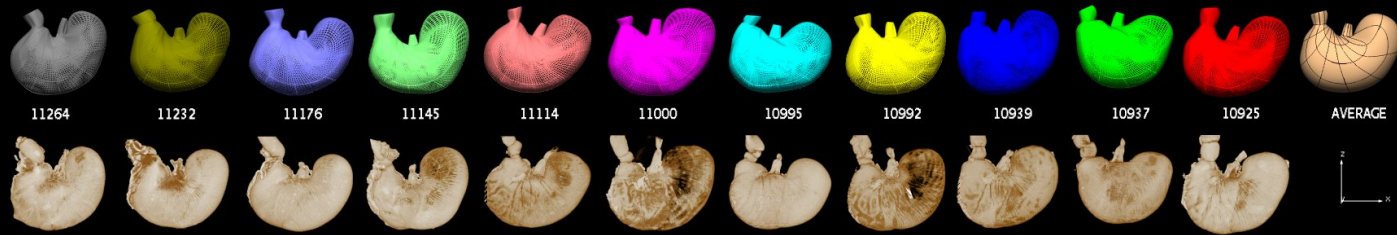**Data from John Furness group at U.Melbourne**
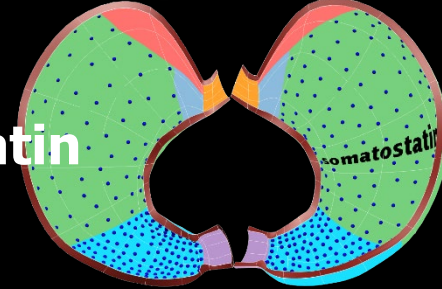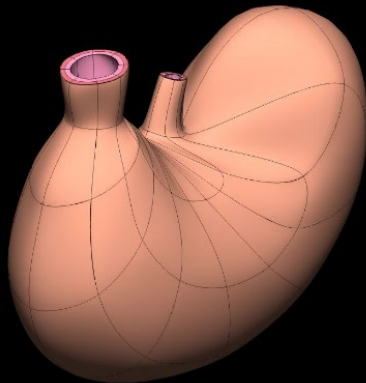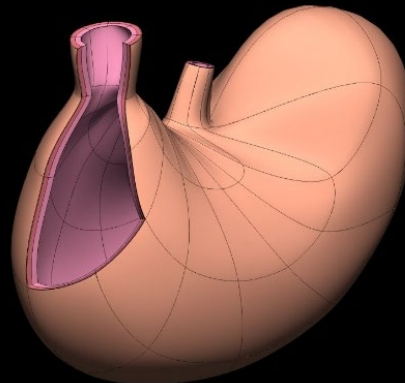
Mapping neurites in the stomach

Data from Terry Powley group at Purdue

Averaging

(a)

(b)   (c)   (d)

DORSAL LONGITUDINAL LAYER
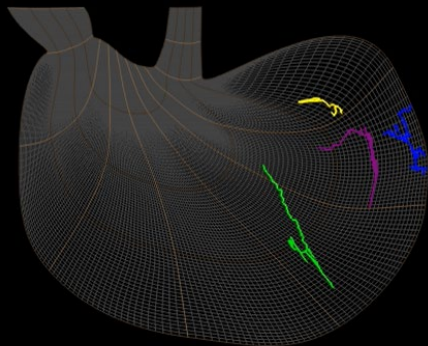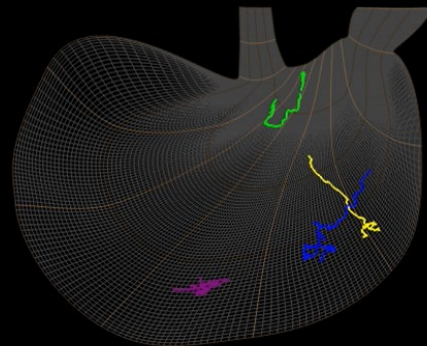DORSAL CIRCULAR LAYER
MUCOSA
VENTRAL CIRCULAR LAYER
VENTRAL LONGITUDINAL LAYER

11264   11232   11176   11145   11114   11000   10995   10992   10939   10937   10925   AVERAGE

(e)   (f)