igmm
INSTITUTE OF GENETICS & MOLECULAR MEDICINE

OMERO & Atlas Informatics

Bill Hill
MRC Human Genetics Unit,
MRC IGMM, University of Edinburgh,
EH4 2XU, UK
Bill.Hill@igmm.ed.ac.uk

June 24, 2013

Overview

Context

Woolz

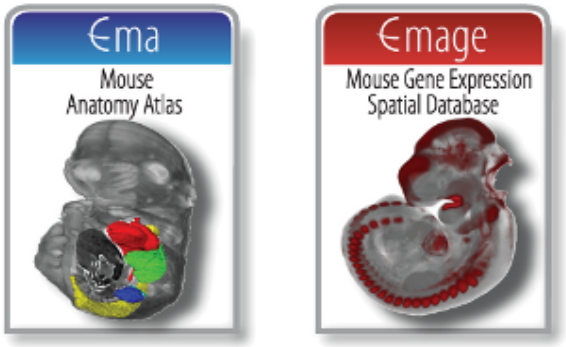
IIP3D

Transformations

Aspirations

Context

www.emouseatlas.org



The e-Mouse Atlas Project

www.gudmap.org

GUDMAP
GenitoUrinary Molecular Anatomy Project

HUDSEN
HUMAN DEVELOPMENTAL STUDIES NETWORK

Virtual Fly Brain

DMDD

echickatlas

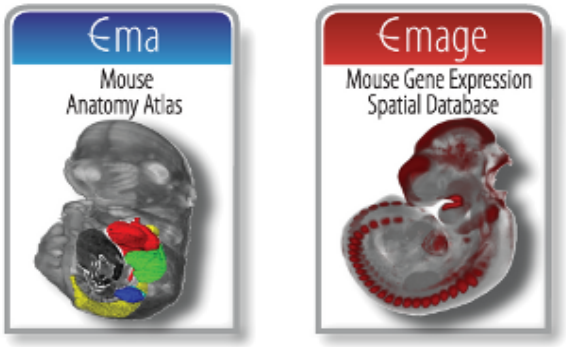
Eurexpress

Eurexpress

EmbryoExpress

Context

www.emouseatlas.org



The e-Mouse Atlas Project

www.gudmap.org

GUDMAP

GenitoUrinary Molecular Anatomy Project

HUDSEN

HUMAN DEVELOPMENTAL STUDIES NETWORK

Virtual Fly Brain

DMDD

echickatlas

Eurexpress

Eurexpress

EmbryoExpress

Woolz 1/2 - Origins (1980s)

FIP - Fast Interval Processor

Metaphase finding, cervical and lung cancer screening, ...

Hardware → Software

Woolz 2/2 - Domains and Values

object ← { type, linkcount, domain, values, properties }

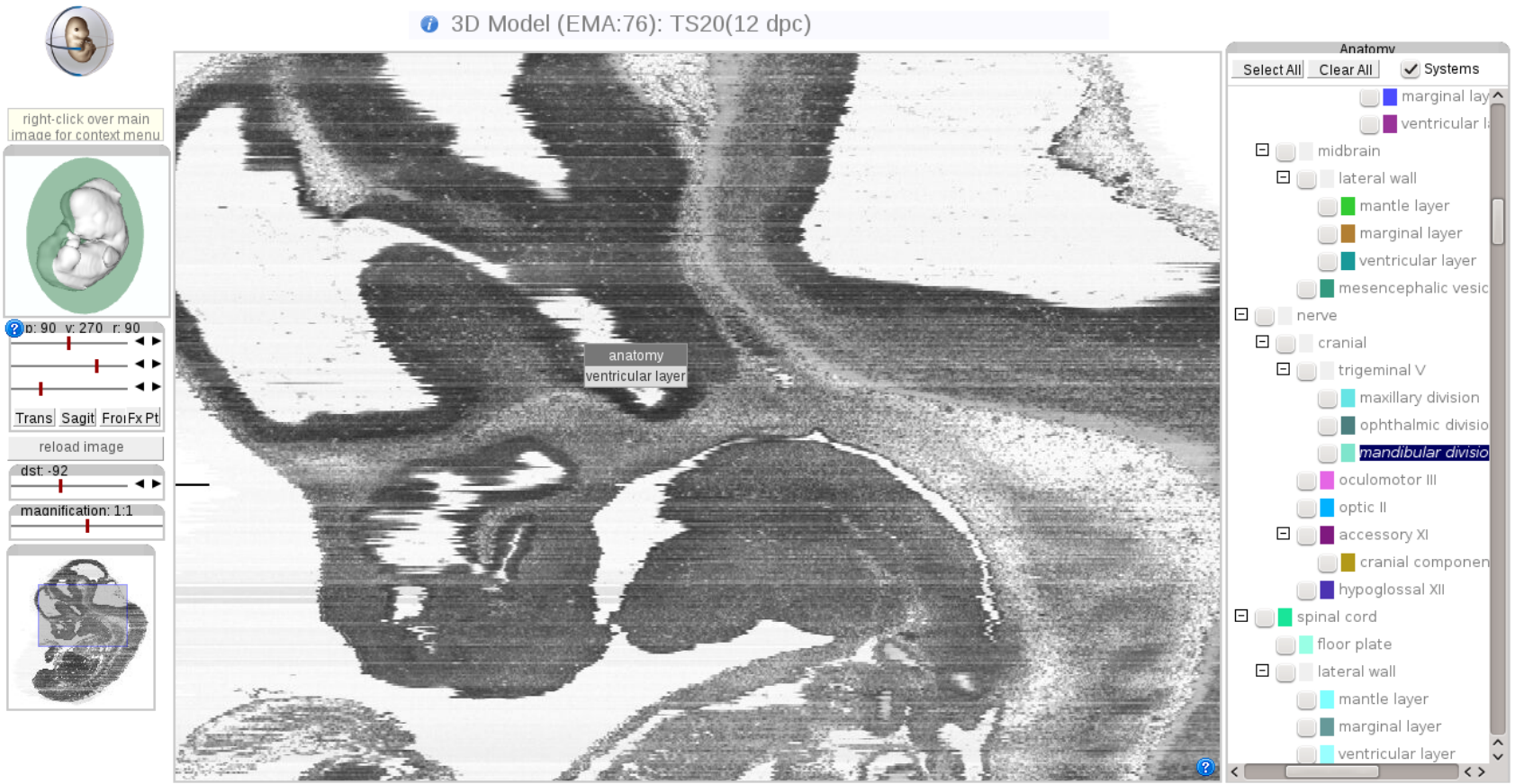
spatial domains,
conforming meshes,
...

(memory mapped)
values, mesh data,

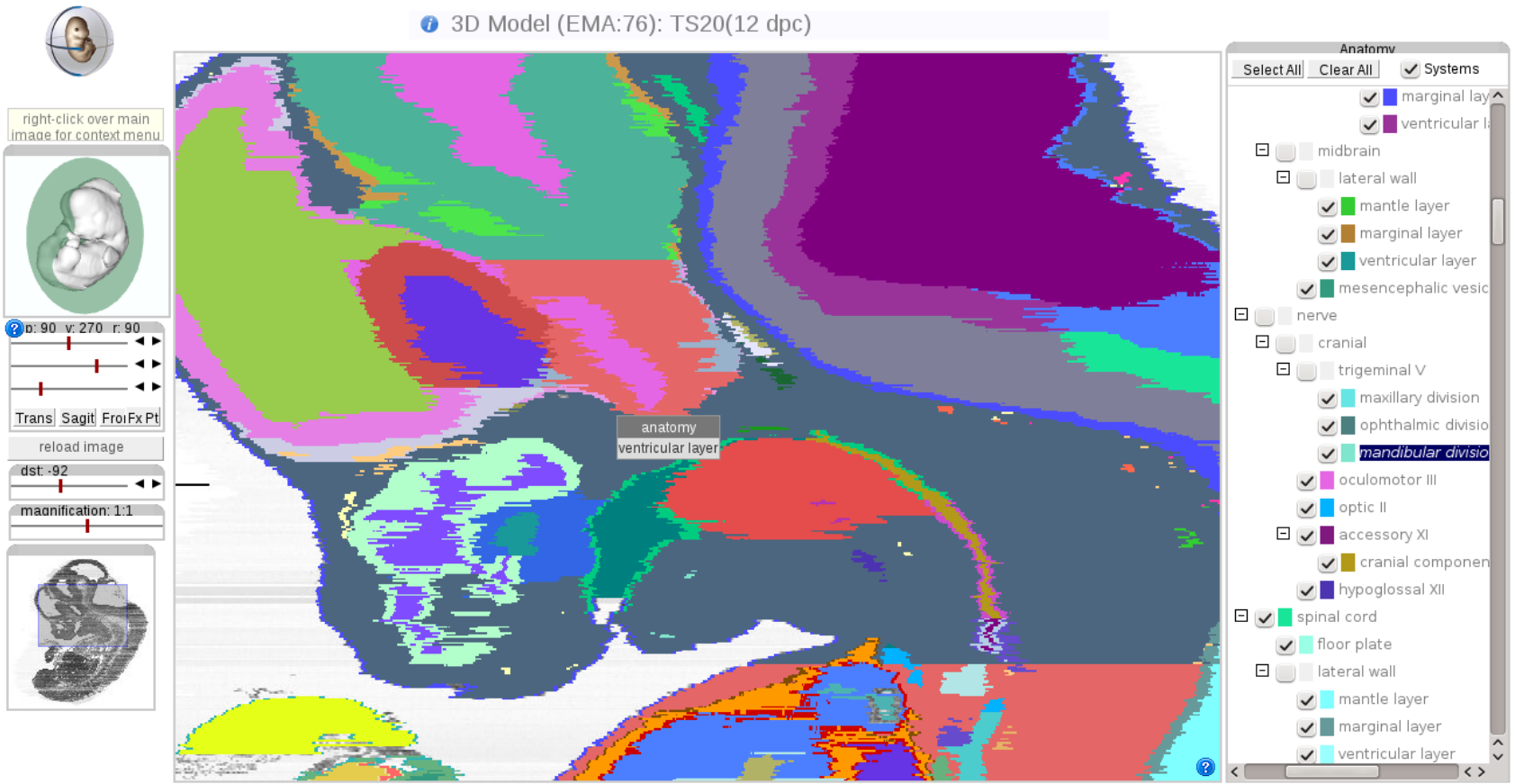
Object Types:

- Images
- Ancillary data (such as provenance)
- Annotation
- Boundaries, surface meshes and geometric models
- Conforming meshes
- Compound objects built from other objects
- Histograms and look up tables
- Transforms basis function, mesh, section

IIP3D 1/5 - Example Application



IIP3D 1/5 - Example Application



IIP3D 2/5 - The IIP3D Protocol

Requests have 4 components

http://a.b.c/fcgi-bin/wlziipsrv.fcgi? WLZ=/obj/a.wlz & DST=4 & QLT=50 & PTL-0,3

Server address

Resource specifier

Parameters

Information request

IIP3D 2/5 - The IIP3D Protocol

Requests have 4 components

http://a.b.c/fcgi-bin/wlziipsrv.fcgi? WLZ=/obj/a.wlz & DST=4 & QLT=50 & PTL-0,3

★ Server address

Resource specifier

Parameters

Information request

IIP3D 2/5 - The IIP3D Protocol

Requests have 4 components

http://a.b.c/fcgi-bin/wlziipsrv.fcgi? WLZ=/obj/a.wlz & DST=4 & QLT=50 & PTL-0,3

Server address

★ Resource specifier

Parameters

Information request

IIP3D 2/5 - The IIP3D Protocol

Requests have 4 components

http://a.b.c/fcgi-bin/wlziipsrv.fcgi? WLZ=/obj/a.wlz & DST=4 & QLT=50 & PTL-0,3

Server address

Resource specifier

★ Parameters

Information request

IIP3D 2/5 - The IIP3D Protocol

Requests have 4 components

http://a.b.c/fcgi-bin/wlziipsrv.fcgi? WLZ=/obj/a.wlz & DST=4 & QLT=50 & PTL-0,3

Server address

Resource specifier

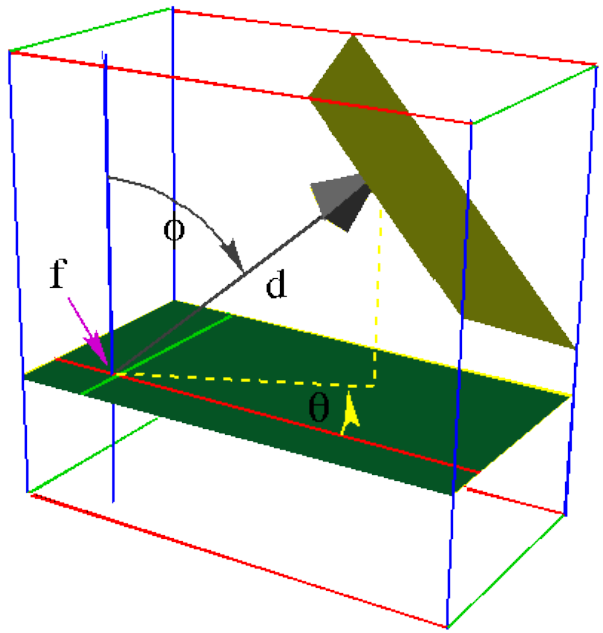
Parameters

★ Information request

IIP3D 3/5 - The IIP3D Protocol

DST	-	distance of the sectioning plane
FXP	-	fixed point of the viewing section (1)
FXT	-	fixed point of the viewing section (2)
MOD	-	projection mode
PIT	-	pitch angle of the section plane
ROL	-	roll angle of the section plane
SCL	-	scale used in sectioning
UPV	-	up vector for the section plane
YAW	-	yaw angle of the section plane

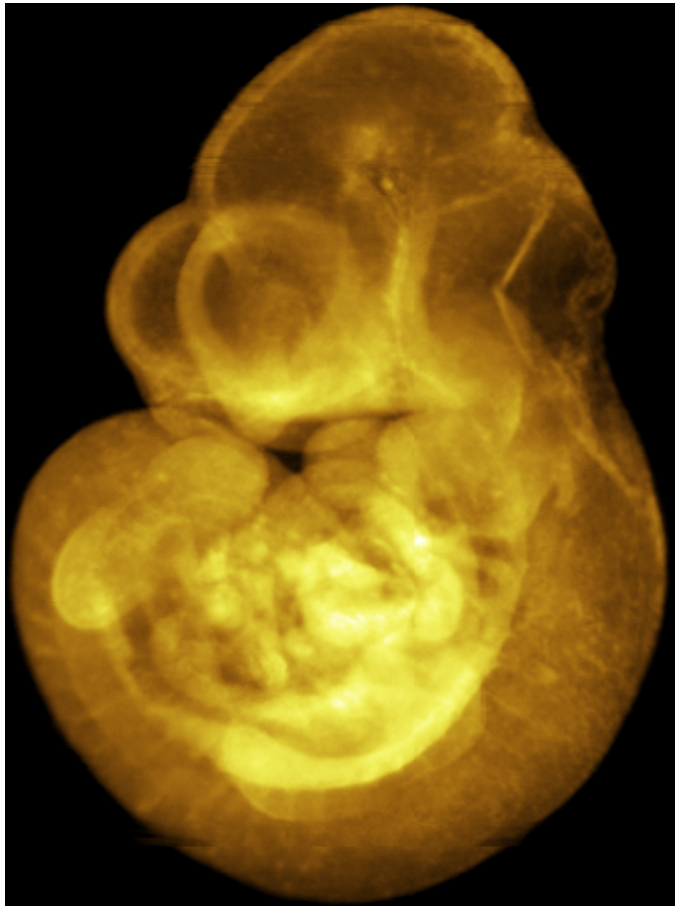
SEL	-	component selection and morphological operations
MAP	-	image value remapping
RMD	-	rendering mode (section | projection)



IIP3D 3/5 - The IIP3D Protocol

DST	-	distance of the sectioning plane
FXP	-	fixed point of the viewing section (1)
FXT	-	fixed point of the viewing section (2)
MOD	-	projection mode
PIT	-	pitch angle of the section plane
ROL	-	roll angle of the section plane
SCL	-	scale used in sectioning
UPV	-	up vector for the section plane
YAW	-	yaw angle of the section plane

SEL	-	component selection and morphological operations
MAP	-	image value remapping
RMD	-	rendering mode (section | projection)



IIP3D 4/5 - Server & Client

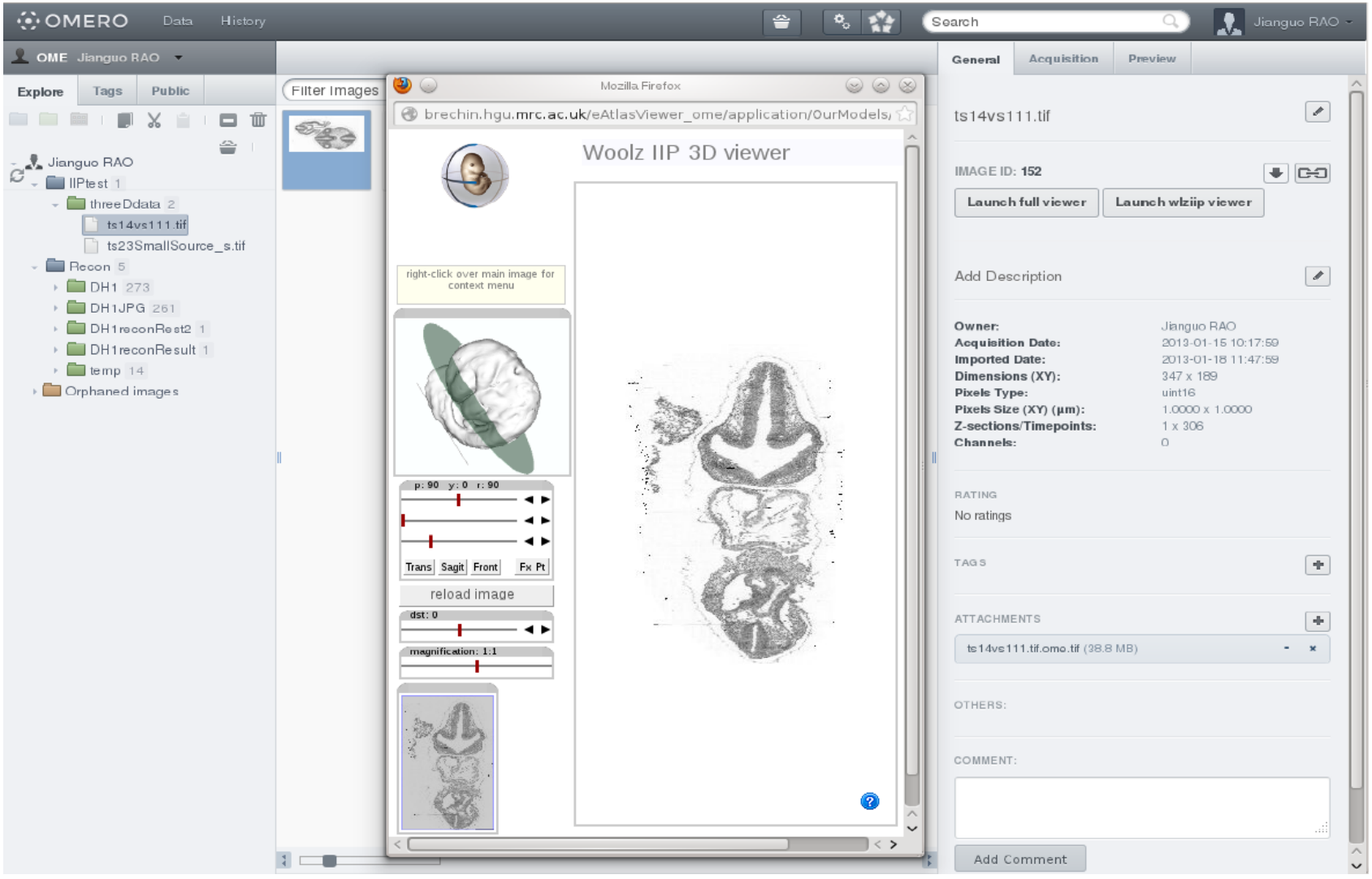
Woolz objects with multiple channels composited on the server to tiles.

Memory mapped values for large size and number of objects.

Browser based IIP3D clients using HTML5.

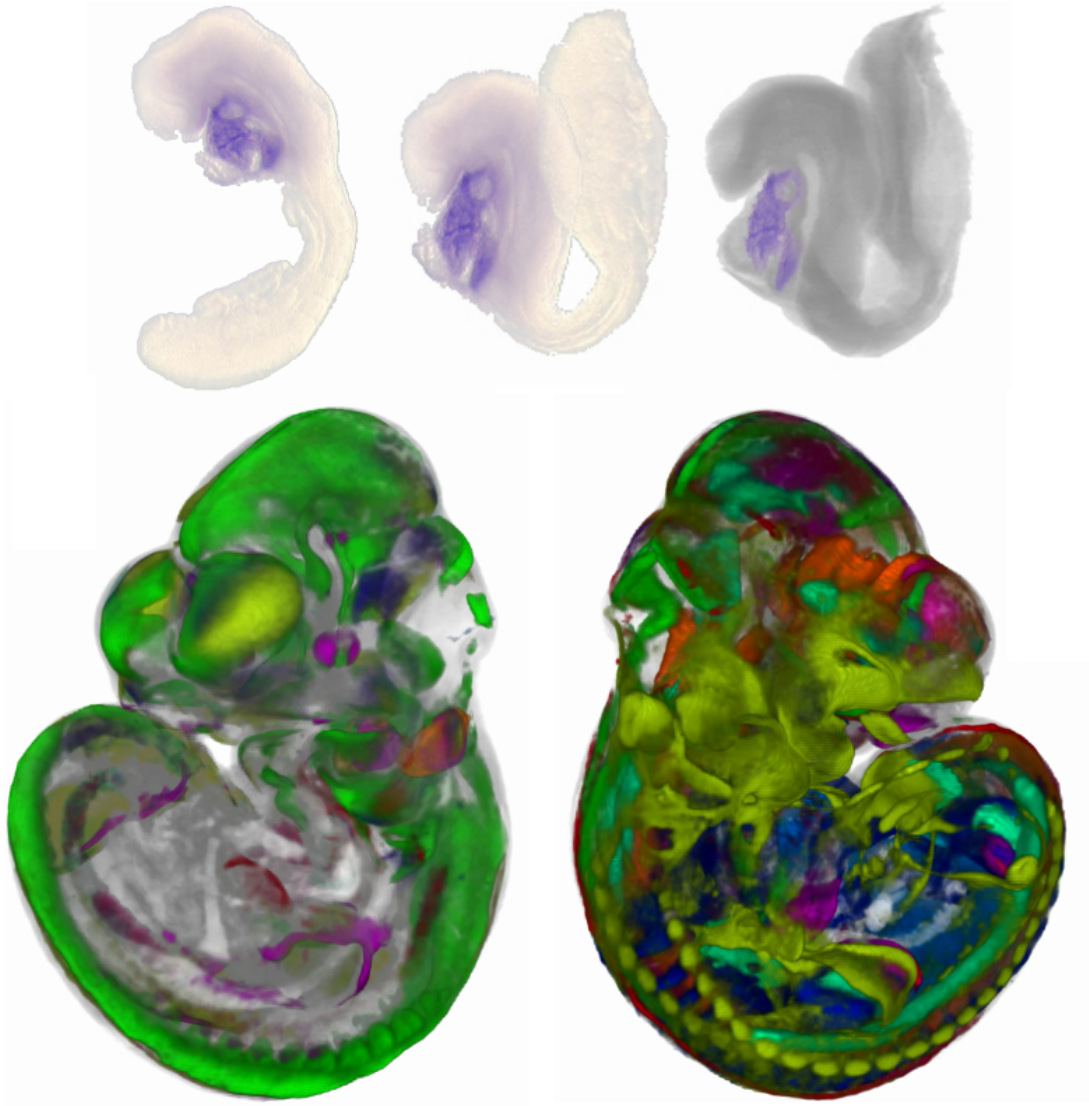
Object queries.

IIP3D 5/5 - Integration with OMERO



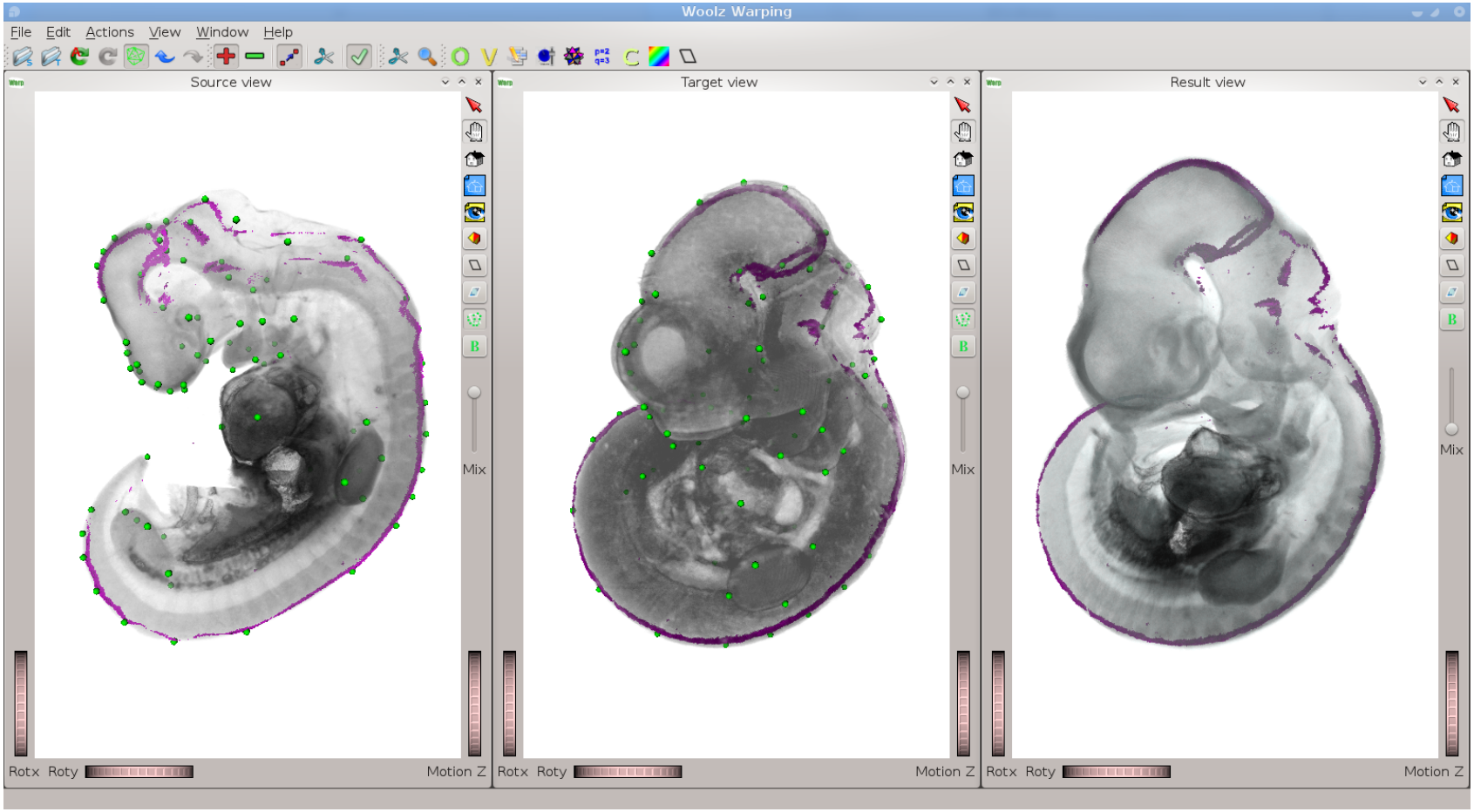
Transformations 1/2 - Examples

EMAGE



Transformations 1/2 - Examples

HUDSEN CS14 → EMAGE TS17

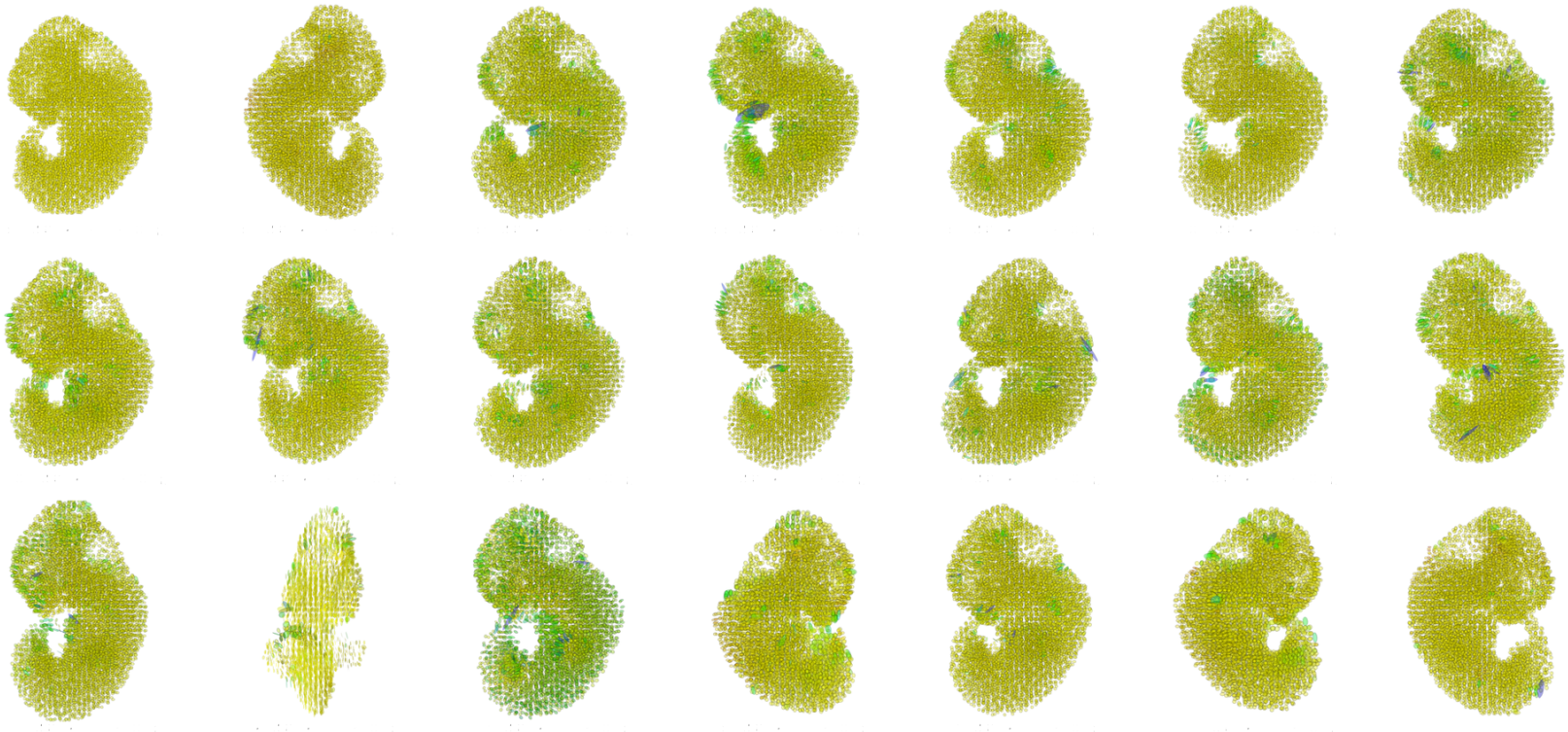


Transformations 2/2 - More Examples

CS14 → TS17

Transformations 2/2 - More Examples

TS17 Population



Aspirations

Extend use of OMERO

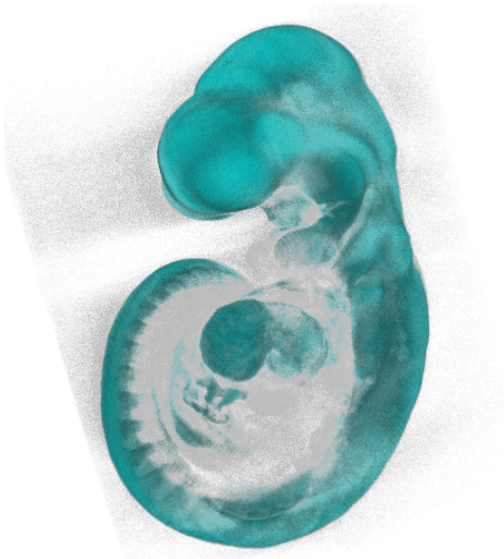
OMERO FS & Woolz objects

Acknowledgements & Links

- Richard Baldock, Jianguo Rao
- EMAGE & EMAP (http://www.emouseatlas.org)
- GUDMAP (http://www.gudmap.org/)
- Hudsen (http://www.hudsen.org/)
- Virtual Fly Brain (http://www.virtualflybrain.org)

- Source (https://github.com/ma-tech)

Woolz Efficiency



Unsigned byte cuboid image 372x279x512 (57MB),

Woolz object after threshold 7.7MB

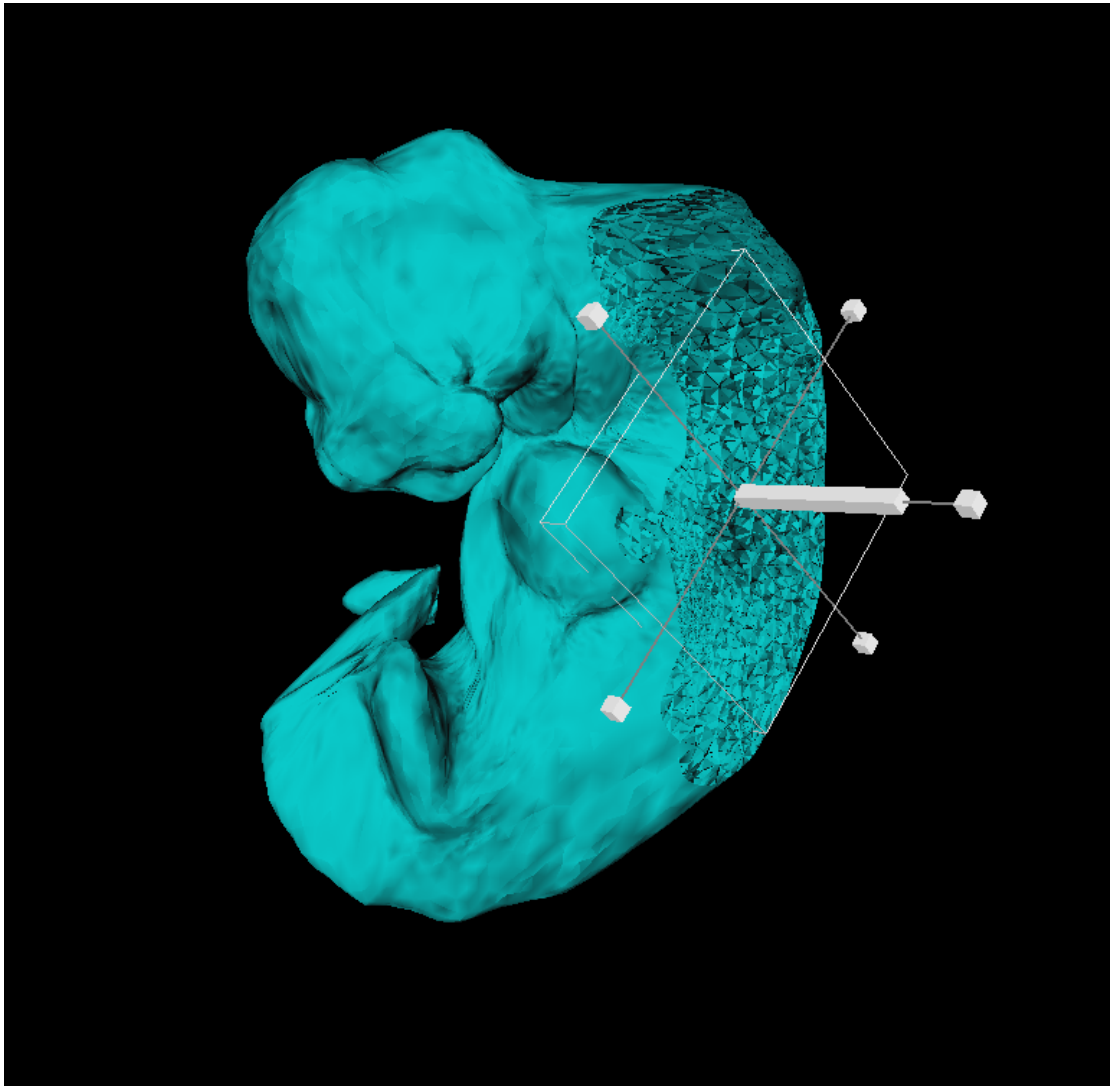
Woolz domain after threshold 2.9MB

	time (ms)			
	Woolz	ITK	imagej	MATLAB
image threshold (>= 32)	34	62	-	-
dilation (C26)	31 (C26)	-	407 (C8)	-
dilation (sphere r=3)	120	3110	-	-
intersection	11	56	-	102

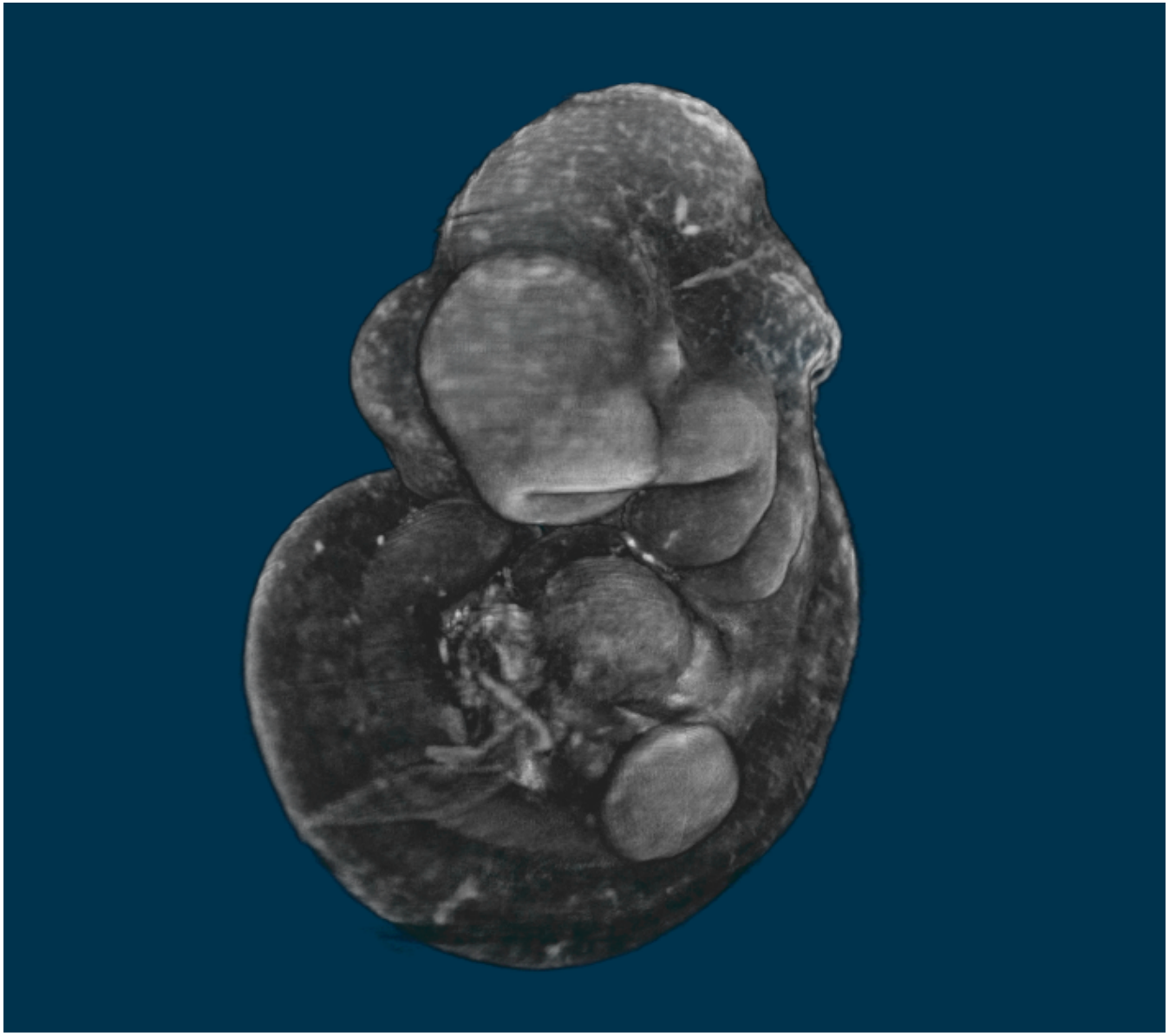
All times for 3.4 GHz Intel i7-2600 quad core CPU

Woolz Conforming Meshes

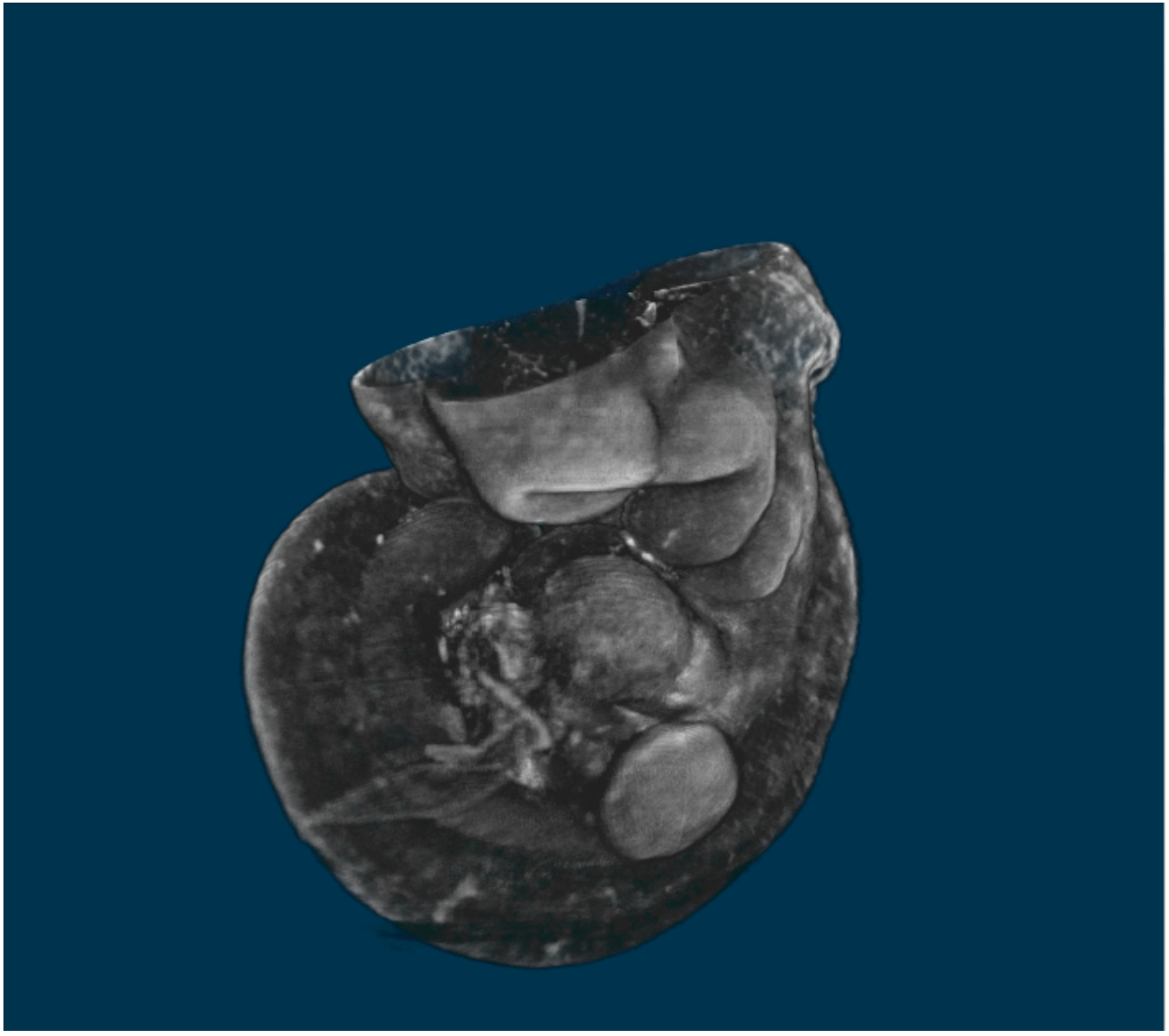
TS17 conforming mesh (62616 nod, 316141 elm)



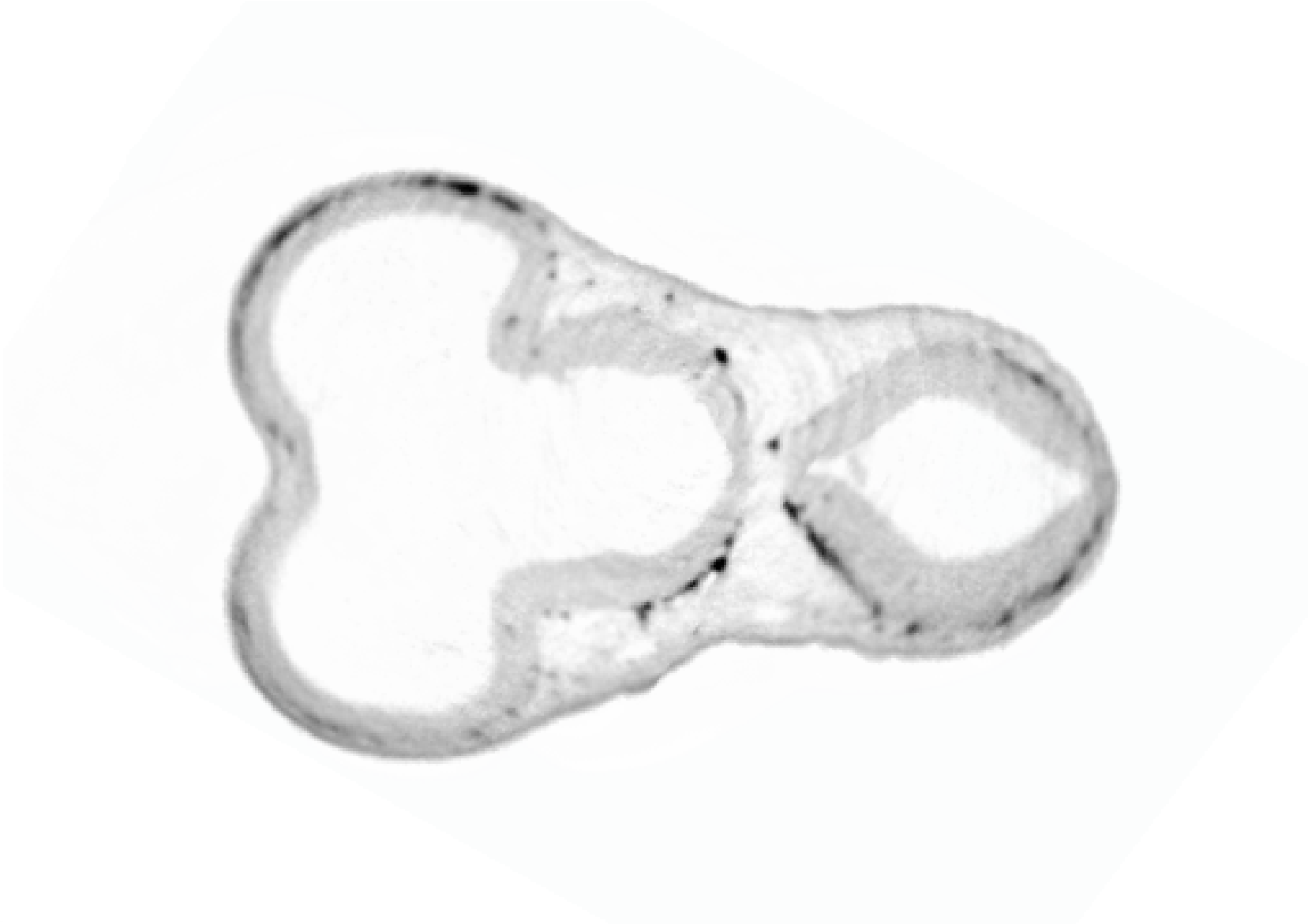
Woolz Intervals and Tiles



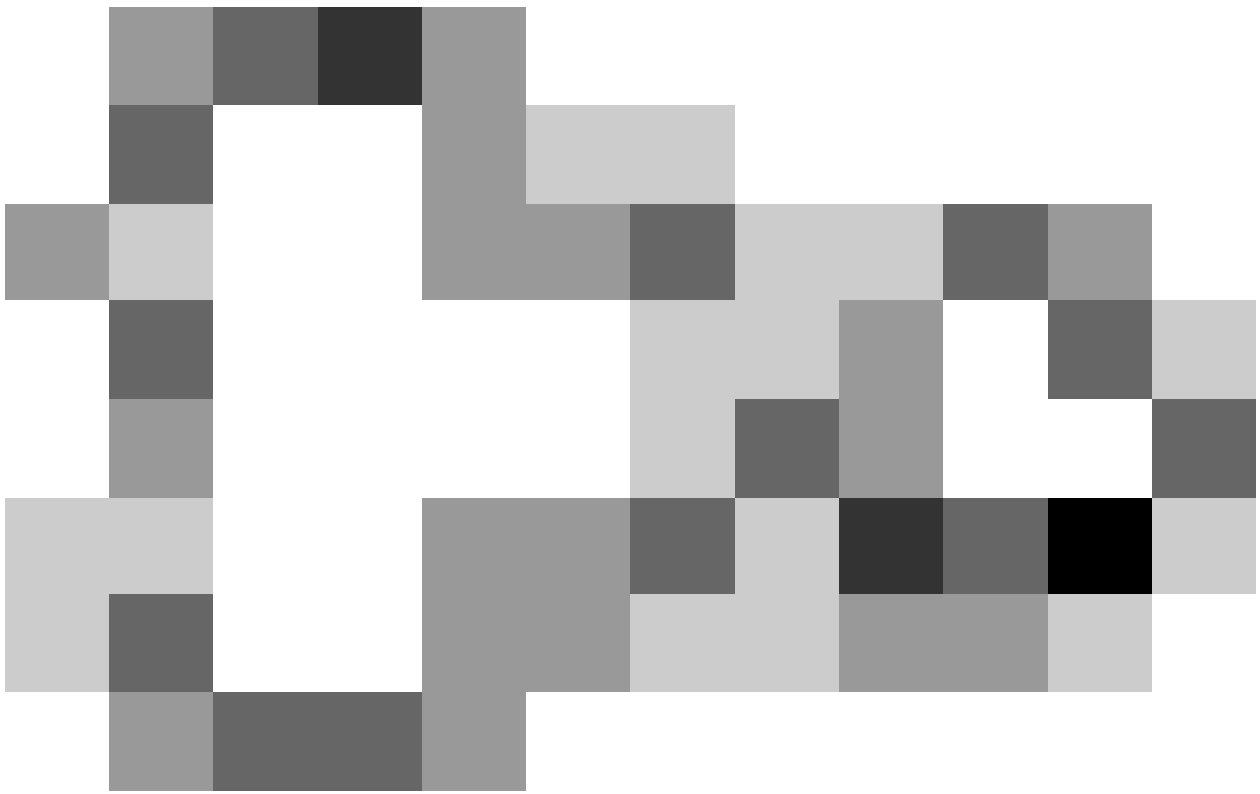
Woolz Intervals and Tiles



Woolz Intervals and Tiles

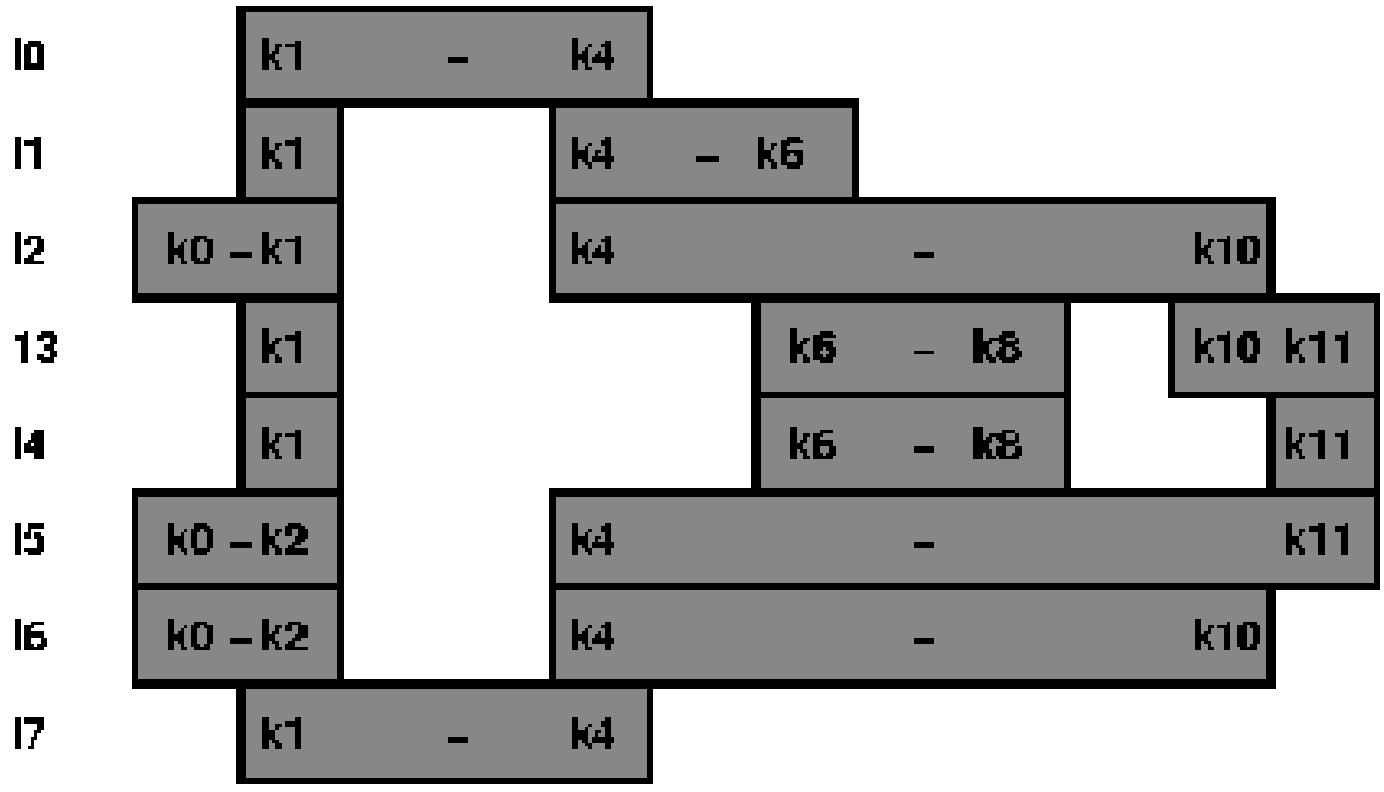


Woolz Intervals and Tiles

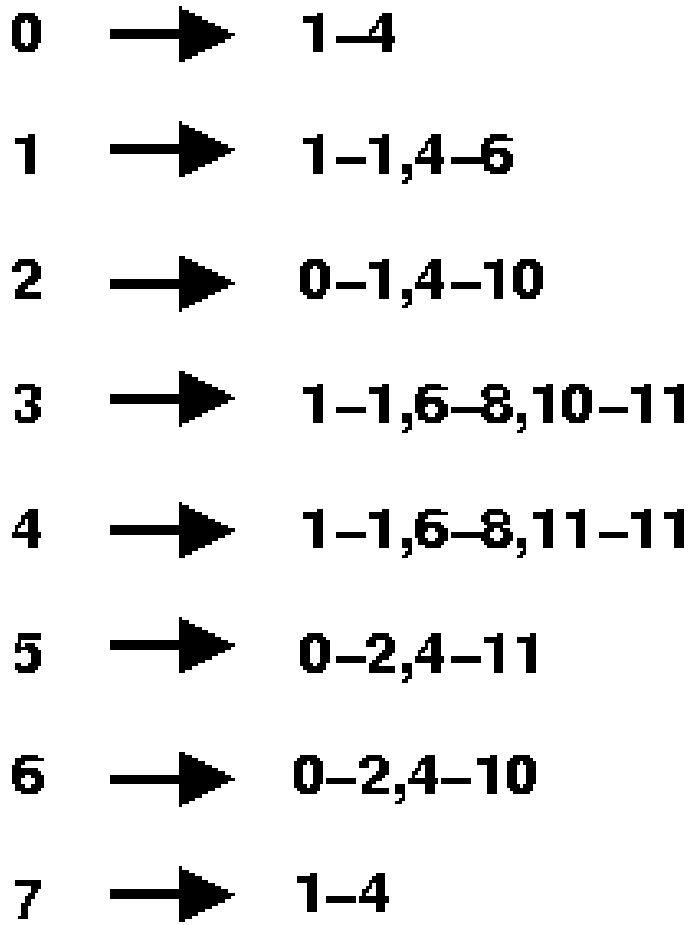


Woolz Intervals and Tiles

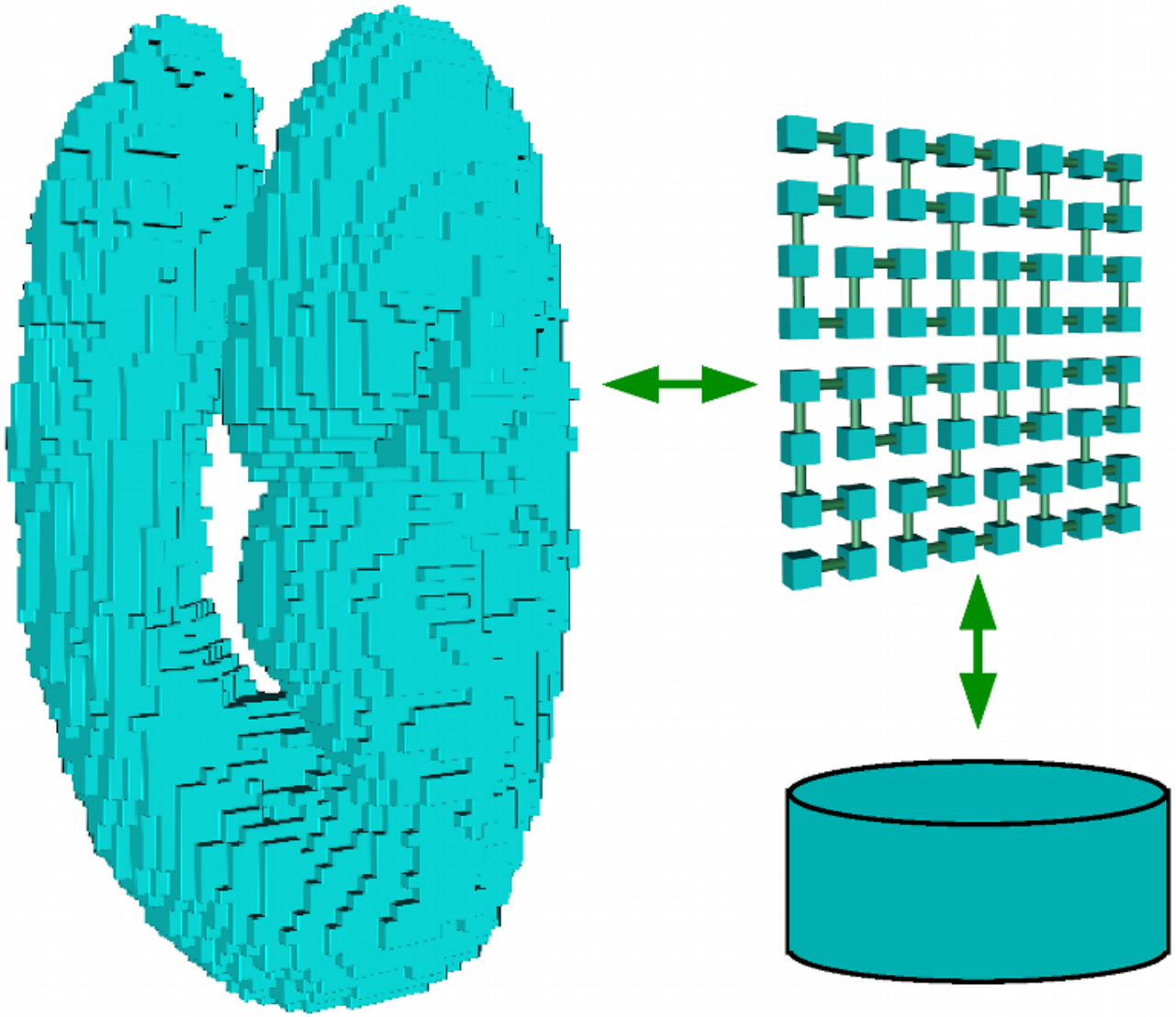
Woolz Intervals and Tiles



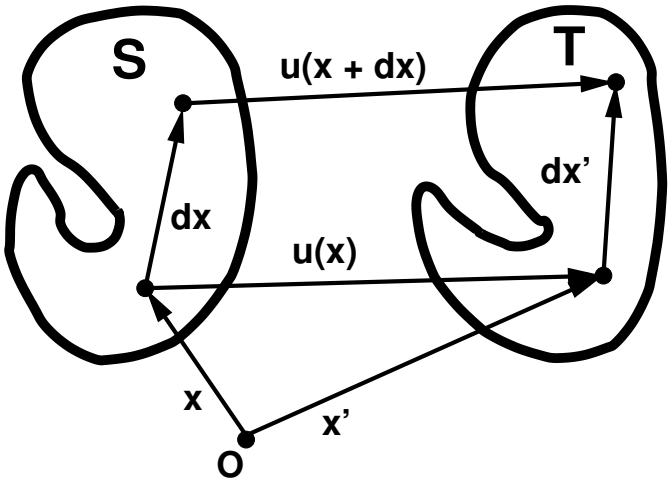
Woolz Intervals and Tiles



Woolz Intervals and Tiles



Tensor Morphometry



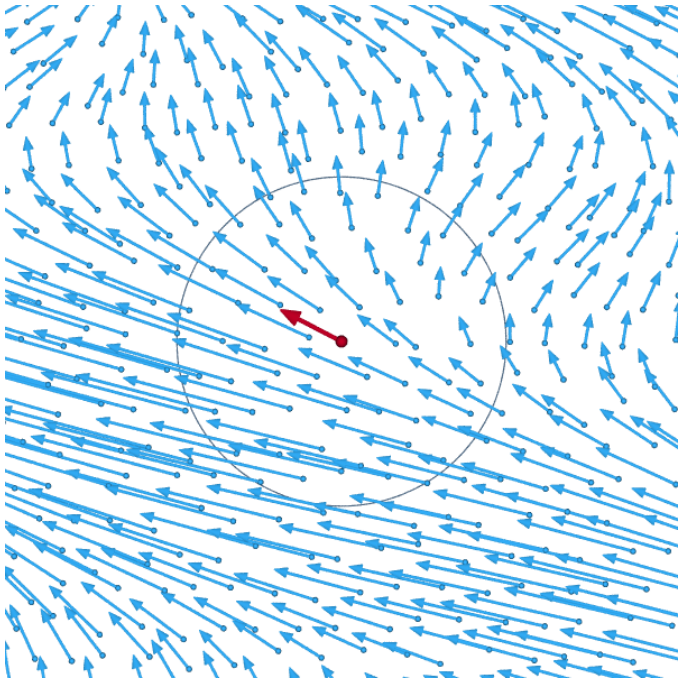
$$\mathbf{x}' + \mathbf{dx}' = \mathbf{x} + \mathbf{dx}' + \mathbf{u}(\mathbf{x} + \mathbf{dx}')$$

$$\mathbf{dx}' = \mathbf{dx} + \nabla(\mathbf{u})\mathbf{dx}$$

$$\epsilon_{ij} = \frac{1}{2}\left(\frac{\partial u_i}{\partial x_j} + \frac{\partial u_j}{\partial x_i}\right)$$

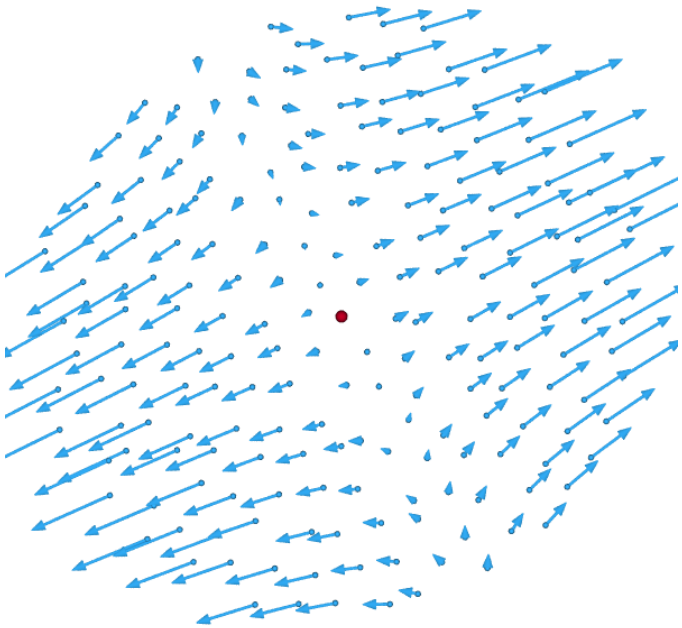
$$\omega_{ij} = \frac{1}{2}\left(\frac{\partial u_i}{\partial x_j} - \frac{\partial u_j}{\partial x_i}\right)$$

Tensor Morphometry



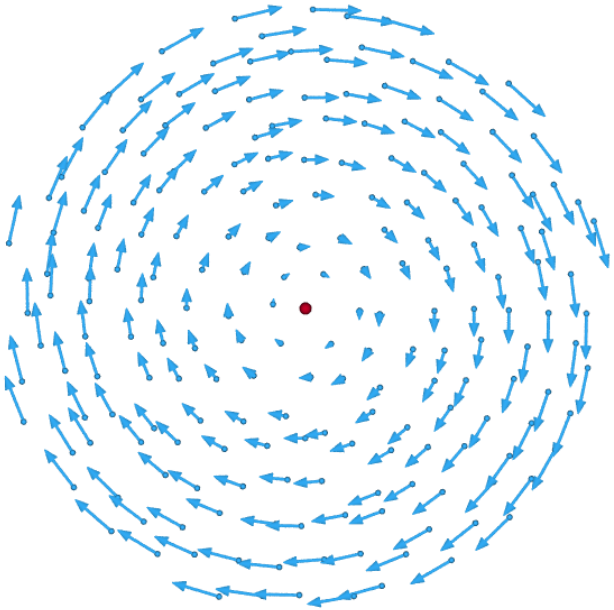
$$
\begin{aligned}
\mathbf{x}' + \mathbf{dx}' &= \mathbf{x} + \mathbf{dx}' + \mathbf{u}(\mathbf{x} + \mathbf{dx}') \\
\mathbf{dx}' &= \mathbf{dx} + \nabla(\mathbf{u})\mathbf{dx} \\
\epsilon_{ij} &= \frac{1}{2}\left(\frac{\partial u_i}{\partial x_j} + \frac{\partial u_j}{\partial x_i}\right) \\
\omega_{ij} &= \frac{1}{2}\left(\frac{\partial u_i}{\partial x_j} - \frac{\partial u_j}{\partial x_i}\right)
\end{aligned}
$$

Tensor Morphometry



$$
\begin{aligned}
\mathbf{x}' + \mathbf{dx}' &= \mathbf{x} + \mathbf{dx}' + \mathbf{u}(\mathbf{x} + \mathbf{dx}') \\
\mathbf{dx}' &= \mathbf{dx} + \nabla(\mathbf{u})\mathbf{dx} \\
\epsilon_{ij} &= \frac{1}{2}\left(\frac{\partial u_i}{\partial x_j} + \frac{\partial u_j}{\partial x_i}\right) \\
\omega_{ij} &= \frac{1}{2}\left(\frac{\partial u_i}{\partial x_j} - \frac{\partial u_j}{\partial x_i}\right)
\end{aligned}
$$

Tensor Morphometry



$$
\begin{aligned}
\mathbf{x}' + \mathbf{dx}' &= \mathbf{x} + \mathbf{dx}' + \mathbf{u}(\mathbf{x} + \mathbf{dx}') \\
\mathbf{dx}' &= \mathbf{dx} + \nabla(\mathbf{u})\mathbf{dx} \\
\epsilon_{ij} &= \frac{1}{2}\left(\frac{\partial u_i}{\partial x_j} + \frac{\partial u_j}{\partial x_i}\right) \\
\omega_{ij} &= \frac{1}{2}\left(\frac{\partial u_i}{\partial x_j} - \frac{\partial u_j}{\partial x_i}\right)
\end{aligned}
$$