ITKv4 – Spatial Objects

Arnaud Gelas – Luis Ibanez
Beyond the Image...
So far...

- Input Image
- FILTER
- Output Image
Only Recently...

Input Mesh → FILTER → Output Mesh
The Future...

Input
Image
Mesh
TimeSequence
...

FILTER

Objects
?
Spatial Objects

\[ \text{itk::ImageSpatialObject} \]

\[ \text{itk::Image} \]
Spatial Objects

`itk::MeshSpatialObject`

`itk::Mesh`
At the Beginning...

SpatialObject

Region of Space

Is \( P \) Inside?
Spatial Objects

The Bounding Box
Spatial Objects

The Bounding Box

Time

Space
Spatial Objects

T1

T2
Spatial Objects

The Bounding Box

Time

Space

T1

T2
We are all connected...

Human

Arm

Hand

Forearm

Liver

Vasculature
Scene Graphs...

- Surgery Table
  - Transform
  - CT Scan 1
    - Transform
      - MRI - A
      - Mesh 1
  - Transform
    - Ultrasound
      - Transform
      - Contour
Scene Graphs...

- Surgery Table 3D
- Transform
- Ultrasound 2D
Scene Graphs...

- Is it a TREE?
- Is it a GRAPH?
We want Numbers!

Spatial Objects → FILTER → Parameters (intensity, Shape, Statistics, speed,...)
We want Numbers!

- Spatial Objects → FILTER → Label Maps
- Label Maps → FILTER → Parameters
Time is more than an Illusion...

Spatial Objects → Spatio Temporal Objects
Time is more than an Illusion...

\((x, y, z, t)\)
Time is more than an Illusion...

\texttt{itk::Point}

At time $T$...
Time is more than an Illusion...

```
 itk::SpatialObject
```

At time $T$...
Time is more than an Illusion...

 itk::SpatialObject

 Or Across Time...
Mikowsky Diagrams...
Mikowsky Diagrams...

History of a 3D object

(x,y,z,t)
Mikowsky Diagrams...

Interpolate in Space and Time

(x, y, z, t)
Mikowsky Diagrams...

Is this a Single 3D+t object?
The Time Continuum...

Spatial Object Time 1 → Spatial Object Time 2

Spatial Object Time 1.5

Time Interpolation?
Topological Changes

(x, y, z, t)

Cellular Mitosis
Topological Changes

Time

Space

(x,y,z,t)

How to Interpolate?
Topological Changes

(x,y,z,t)

Cellular Fusion
Topological Changes

How to Interpolate?

(x,y,z,t)
End
Discussion

- Model to image registration
  - Optimize over SO, shape parameters
- Moving from App level representation towards the lower level in ITK (e.g. to share among apps such as V3D, GoFigure,...)
- Create a itk::GraphObject?
  - Use Boost graph library? (as a module)
  - Nick wrote one...(at the time we didn't want Boost..)
  - Data in nodes & data in edges (e.g. transforms)
Discussion

- What information to put in Nodes?
  - What to put in Edges?
- How to manage IO?
  - get it from boost?
  - Use graphviz?
- ItkGraphObject
  - Nodes → Template argument
  - Edge →
Discussion

- What information to put in Nodes?
  - What to put in Edges?
- How to manage IO?
  - get it from boost?
  - Use graphviz?
- ItkGraphObject
  - Nodes → Template argument
  - Edge →