Image Plugin

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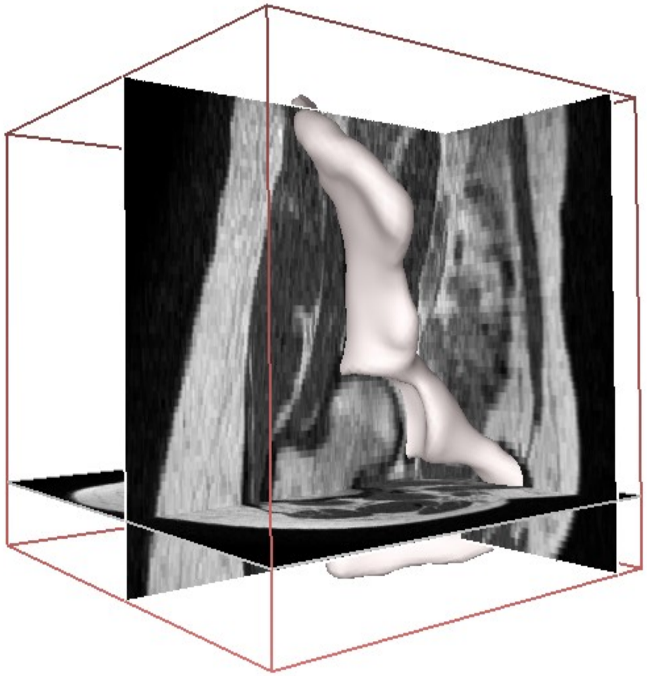
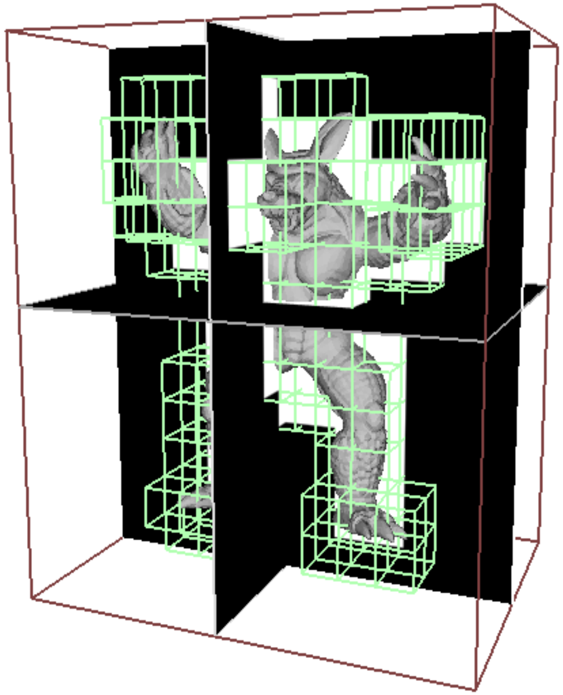
21/10/13





Overview

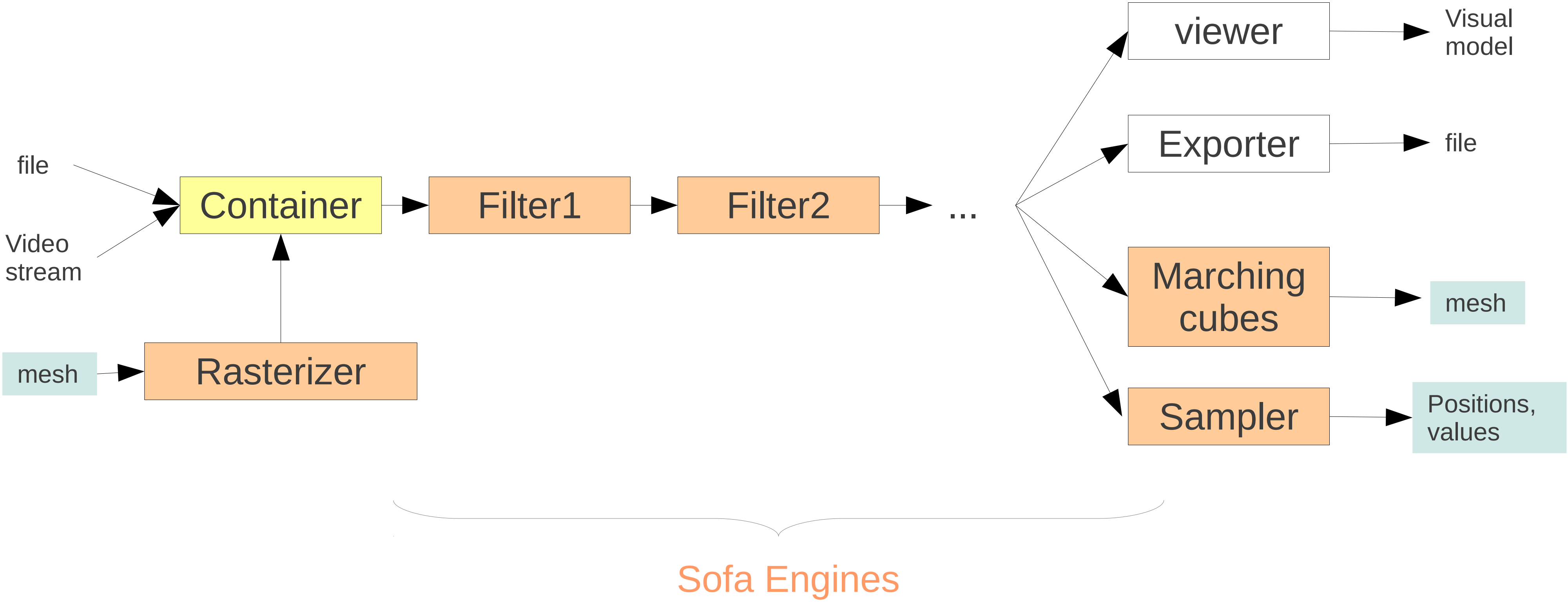

file
Video stream
Container
Filter1
Filter2
...
mesh
Rasterizer
viewer
Visual model
Exporter
file
Marching cubes
mesh
Sampler
Positions, values
Sofa Engines

Image data

- Based on CImg opensource library http://cimg.sourceforge.net/
  - Import/export in standard formats : bmp, jpeg, mpg, hdr, mhd+raw ...

    Handles image orientation, position, pixel size
- Templated on the pixel type
  - ImageC = Image<char>, ImageUC = Image<unsigned char>, ImageD = Image<double>, ImageB = Image<bool>, etc.
- Most components templated on the image type :
  - e.g. <ImageViewer template='ImageD' />
- Five dimensions : x, y, z, channels, t

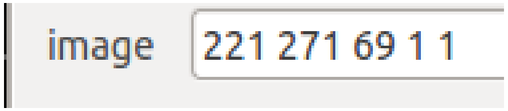
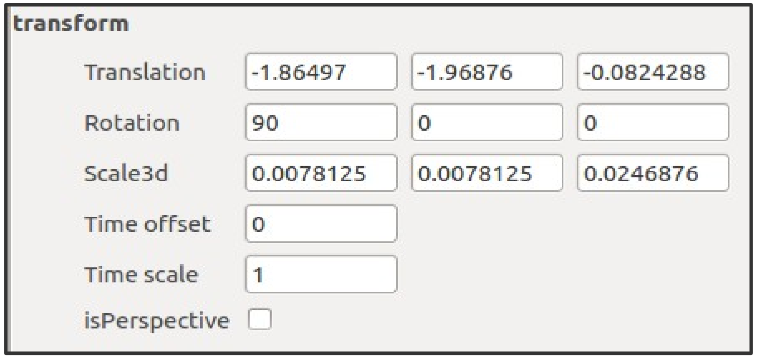


image 221 271 69 1 1

- Shared memory → no overhead when using data links
  - e.g. <ImageFilter inputImage= '@ container.image' />

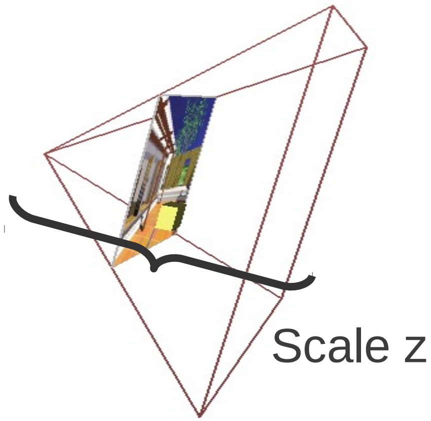
Transform data

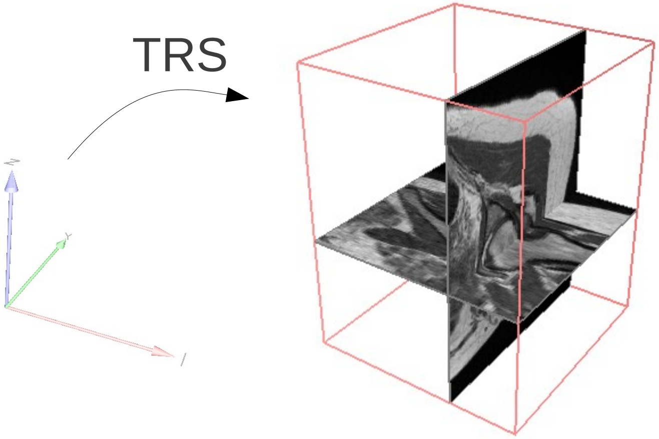
- Each Image is associated to a transformation
  - Encasulated into a single data to simplify linking across components
    (an engine is available to allow conversion from individual fields)
  - One type to minimize the number of instanciations
  - Linear transformation in the spatio-temporal domain
  - Can be turned into a perspective transformation
    - Pinhole camera intrinsics :
      - fx = scalez /(2 × scalex), fy = scalez /(2 × scaley)
      - cx = (dimx − 1)/2, cy = (dimy − 1)/2



transform

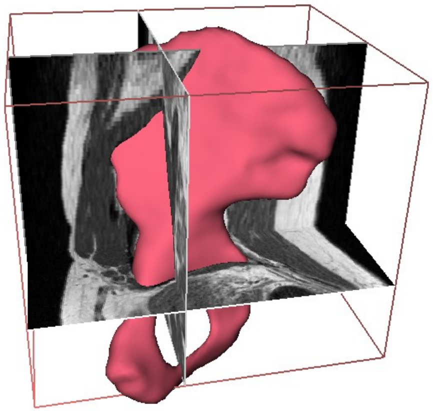
Translation	-1.86497	-1.96876	-0.0824288
Rotation	90	0	0
Scale3d	0.0078125	0.0078125	0.0246876
Time offset	0		
Time scale	1		
isPerspective	□		

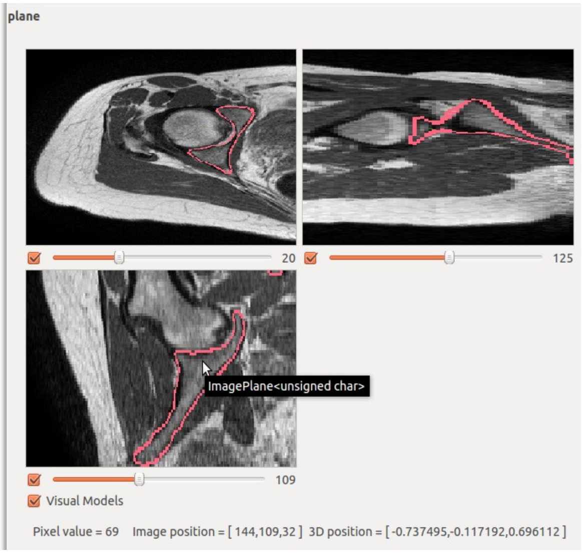




Viewer

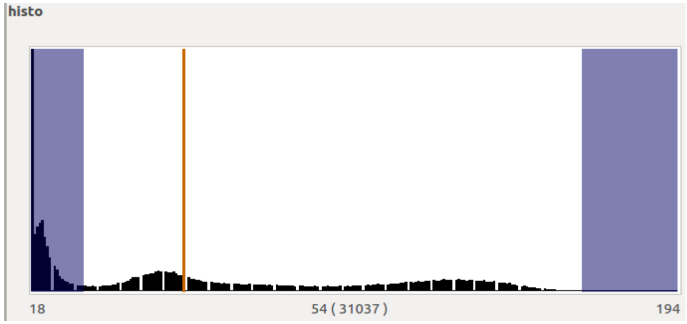
- 'Plane' data to tune multi-planar rendering (MPR)
  - e.g. <ImageViewer plane=' 125 109 20' />
  - Visual model « slice through » visualization
  - Zoom using 'ctrl' key



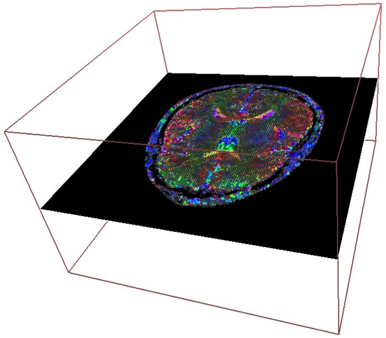


Pixel value = 69   Image position = [144,109,32] 3D position = [-0.737495,-0.117192,0.696112]

- 'Histo' data to tune window/level



- Vector/tensor visu for multi channel images



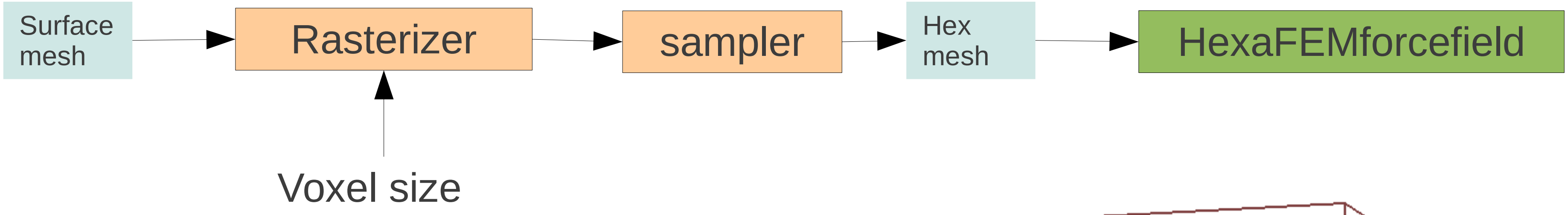
Filtering

- A single engine for all the standard filters
  - Blur, crop, threshold, distance, resample, etc...
  - e.g. smoothing :

```
<Node>
    <ImageContainer  name="image" filename="data/pelvis_f.raw" />

    <ImageFilter  name="filter"  filter="1" param="2" inputImage="@image.image" inputTransform="@image.transform" />

                                                         src="@image"

    <ImageViewer      image="@filter.outputImage" transform="@filter.outputTransform" />

                                     src="@filter"

</Node>
```

Generation of volumetric meshes

sampler_HexaFEM.scn



Surface mesh

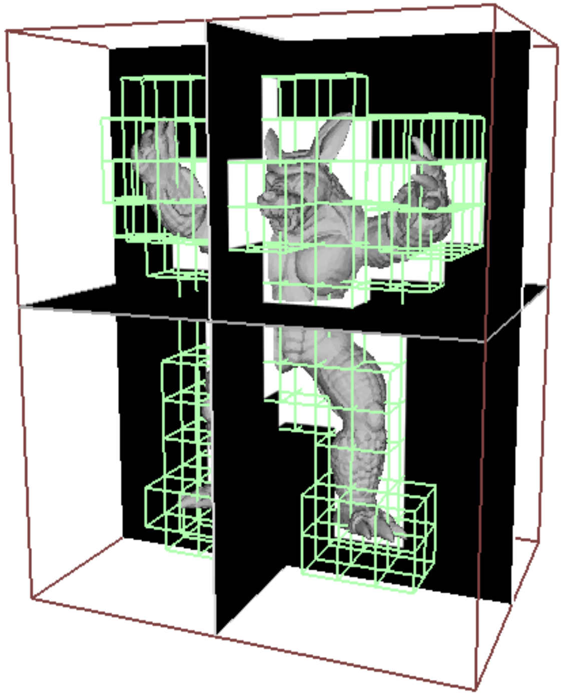
Rasterizer

sampler

Hex mesh

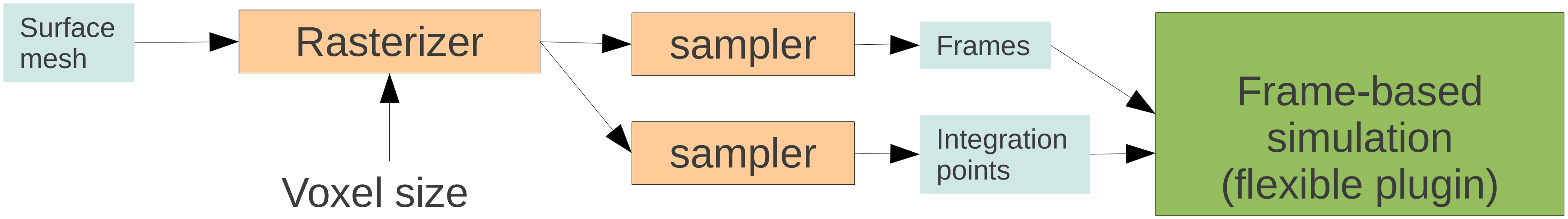
HexaFEMforcefield

Voxel size



Generation of frame model

MeshToImage_Frame.scn



Surface mesh

Rasterizer

Voxel size

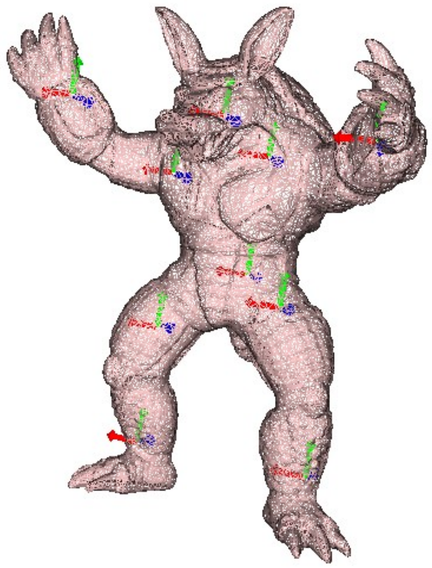
sampler

sampler

Frames

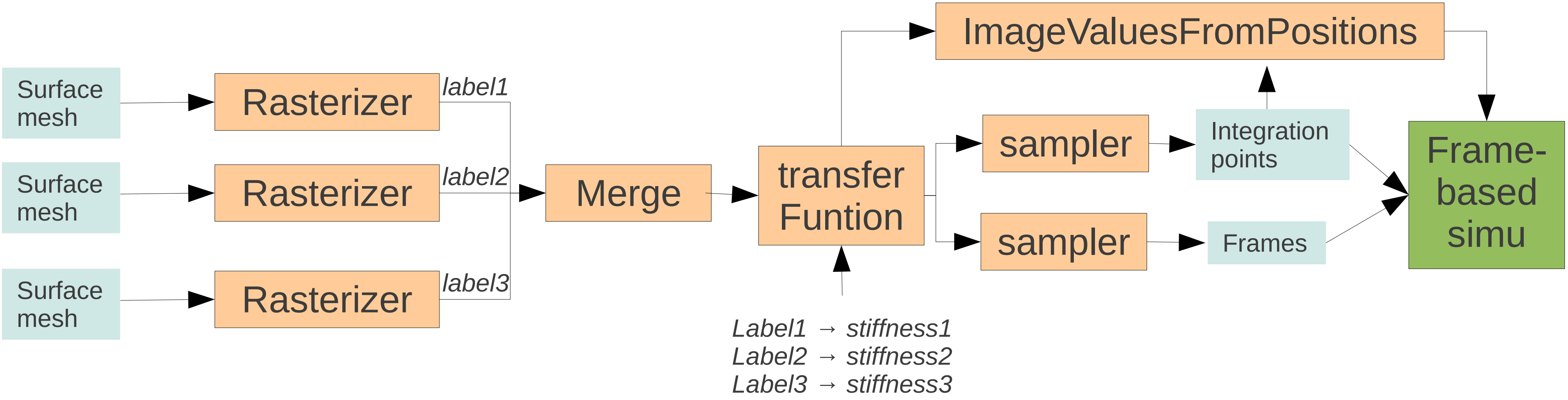
Integration points

Frame-based simulation (flexible plugin)



Modeling heterogeneous materials

MeshToImage_Frame2.scn



Surface mesh

Surface mesh

Surface mesh

Rasterizer

Rasterizer

Rasterizer

label1

label2

label3

Merge

transfer Funtion

Label1 → stiffness1
Label2 → stiffness2
Label3 → stiffness3

ImageValuesFromPositions

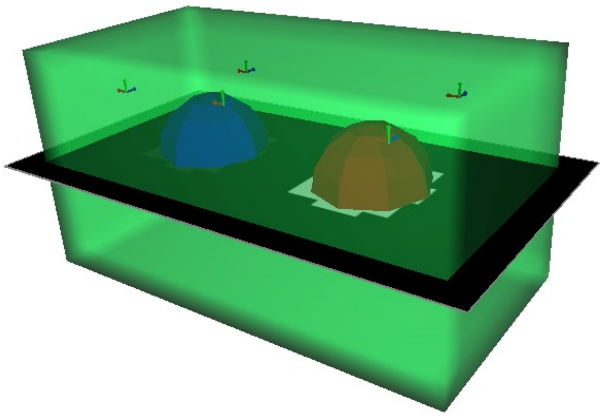
sampler

sampler

Integration points

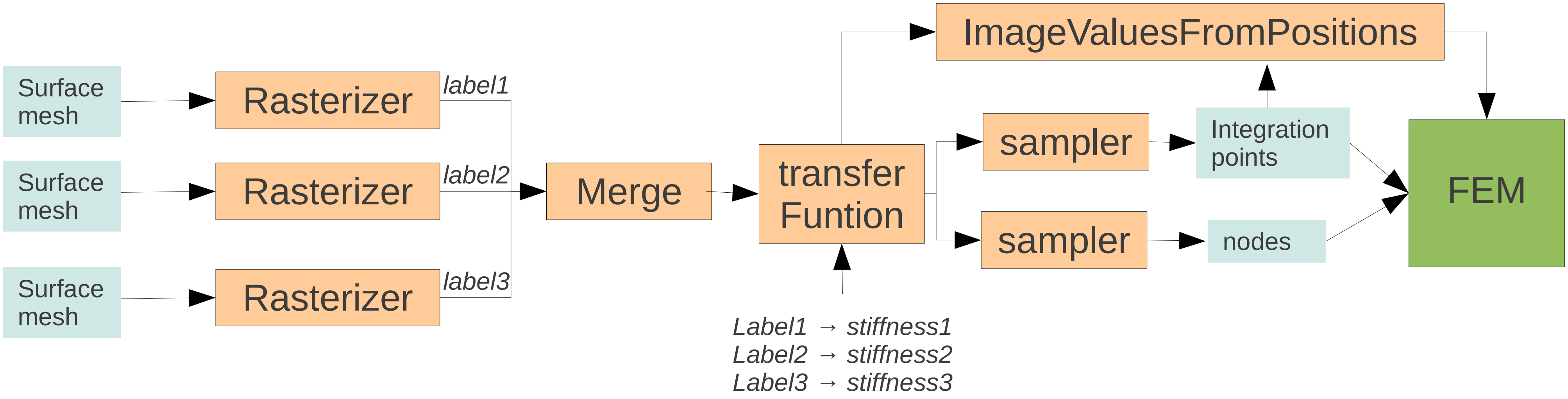
Frames

Frame-based simu



Representing heterogeneous materials

MeshToImage_Hexa.scn



Surface mesh

Rasterizer

label1

Surface mesh

Rasterizer

label2

Surface mesh

Rasterizer

label3

Merge

transfer Funtion

Label1 → stiffness1
Label2 → stiffness2
Label3 → stiffness3

ImageValuesFromPositions

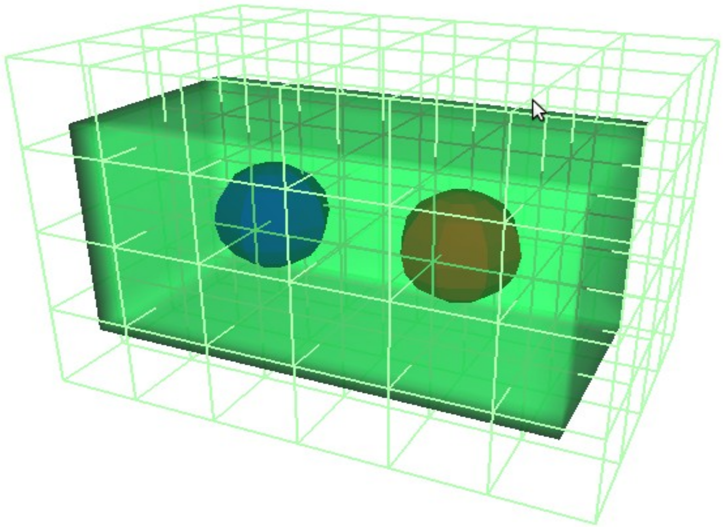
sampler

Integration points

sampler

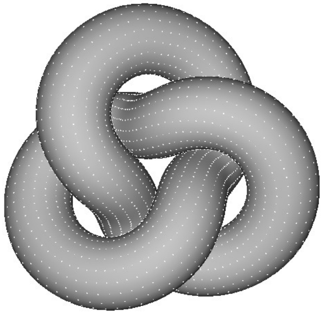
nodes

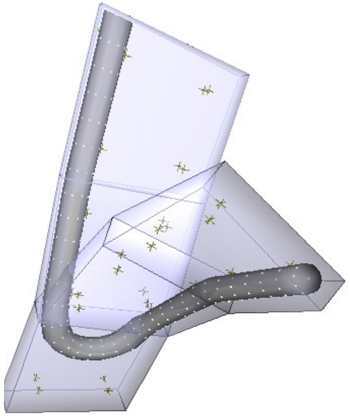
FEM

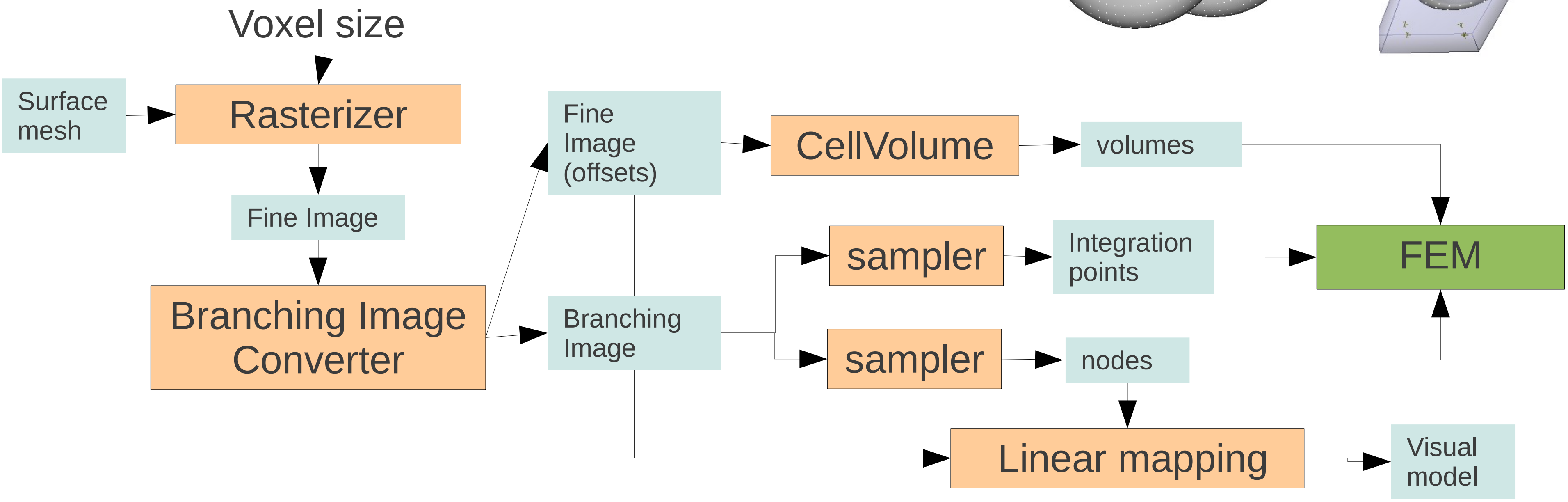


Branching images

Flexible/demos/BranchingImage_HexaFEM.scn



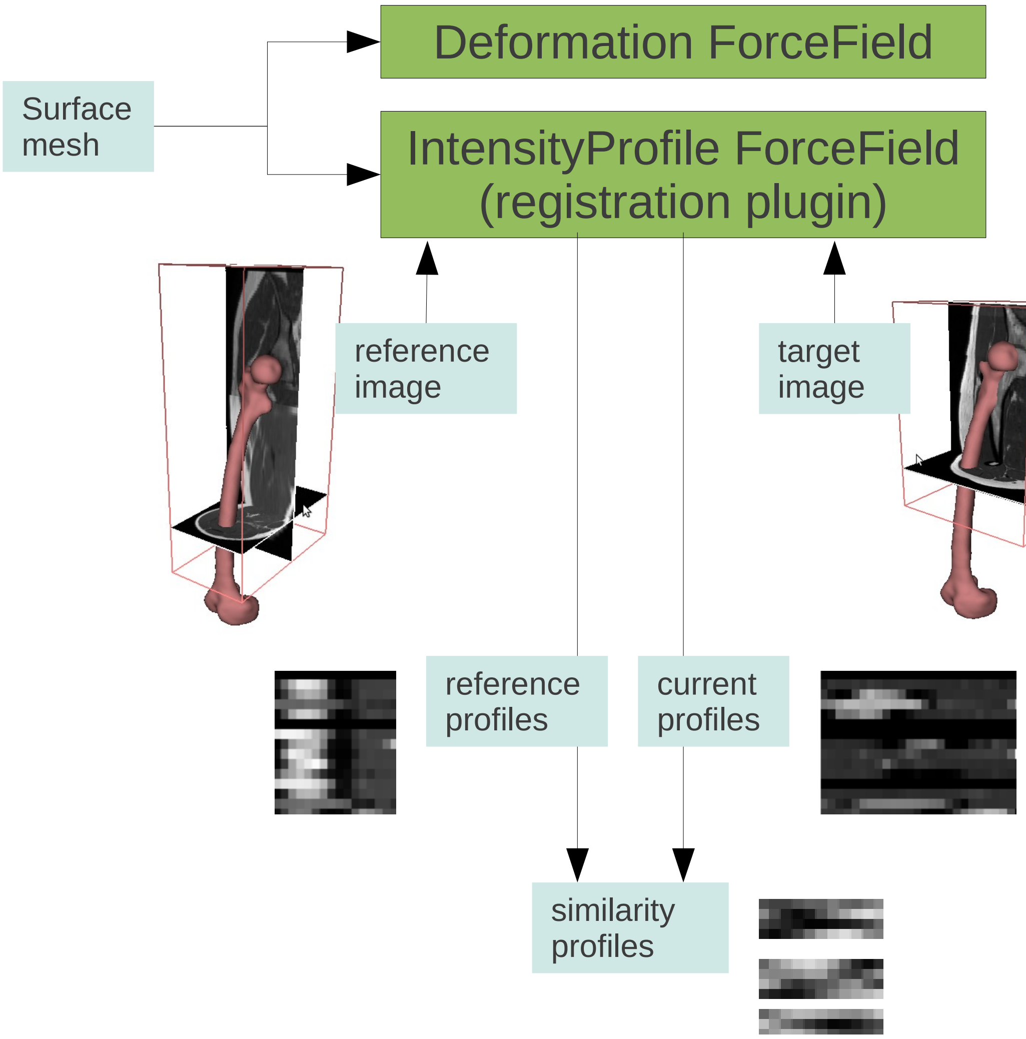




Allows superposition of voxels
→ sparse untangled FEM/meshless discretizations
→ contact/attachment modeling through branching cell topology

Registration

Registration/imageregistration.scn



Surface mesh

Deformation ForceField

IntensityProfile ForceField (registration plugin)

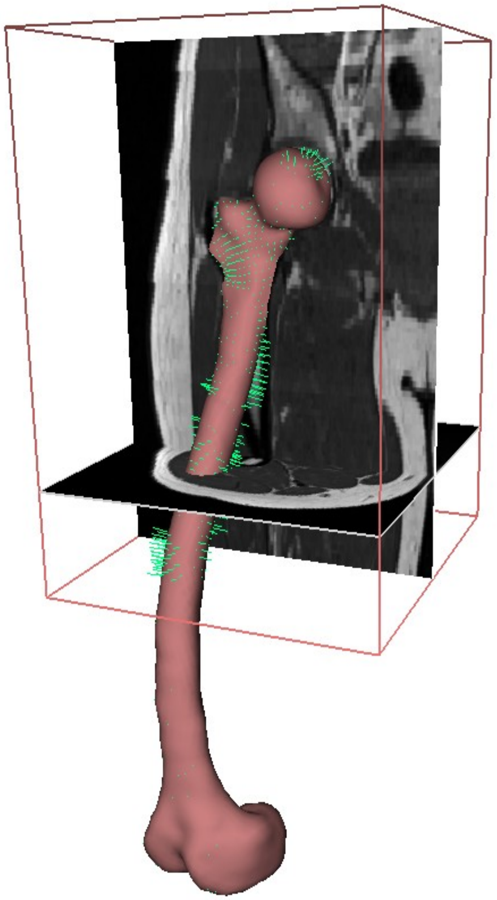
reference image

target image

reference profiles

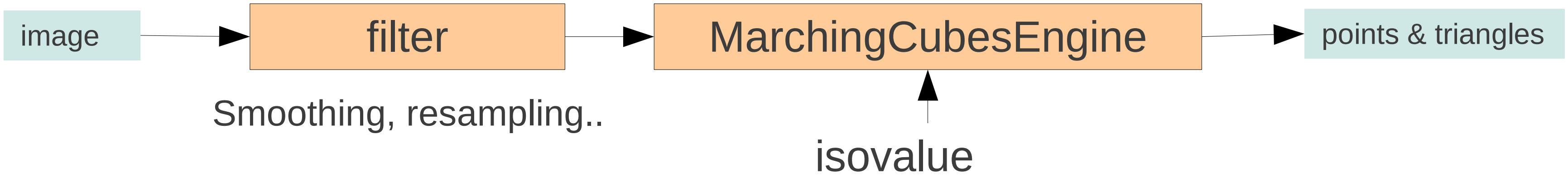
current profiles

similarity profiles



Generation of iso-surfaces

marchingCubes.scn



image

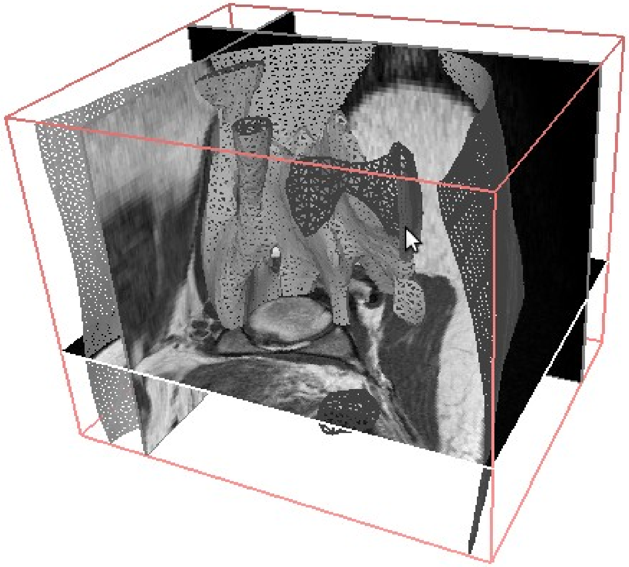
filter

MarchingCubesEngine

points & triangles

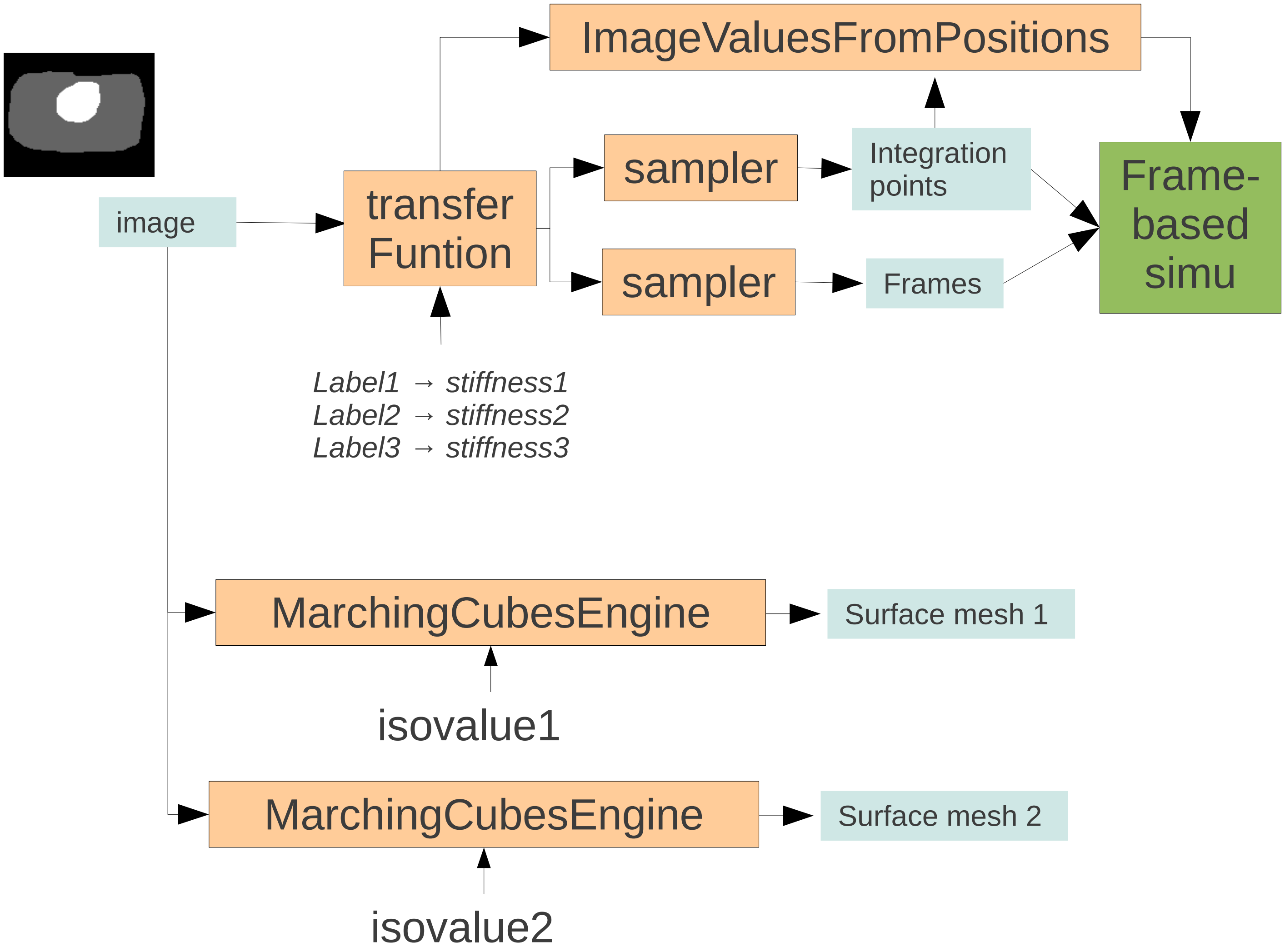
Smoothing, resampling..

isovalue



Generation of a complete simulation

Flexible/demos/plate.scn



ImageValuesFromPositions

image

transfer Funtion

sampler

Integration points

sampler

Frames

Frame-based simu

Label1 → stiffness1
Label2 → stiffness2
Label3 → stiffness3

MarchingCubesEngine

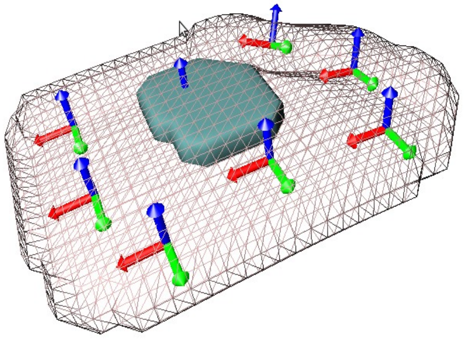
Surface mesh 1

isovalue1

MarchingCubesEngine

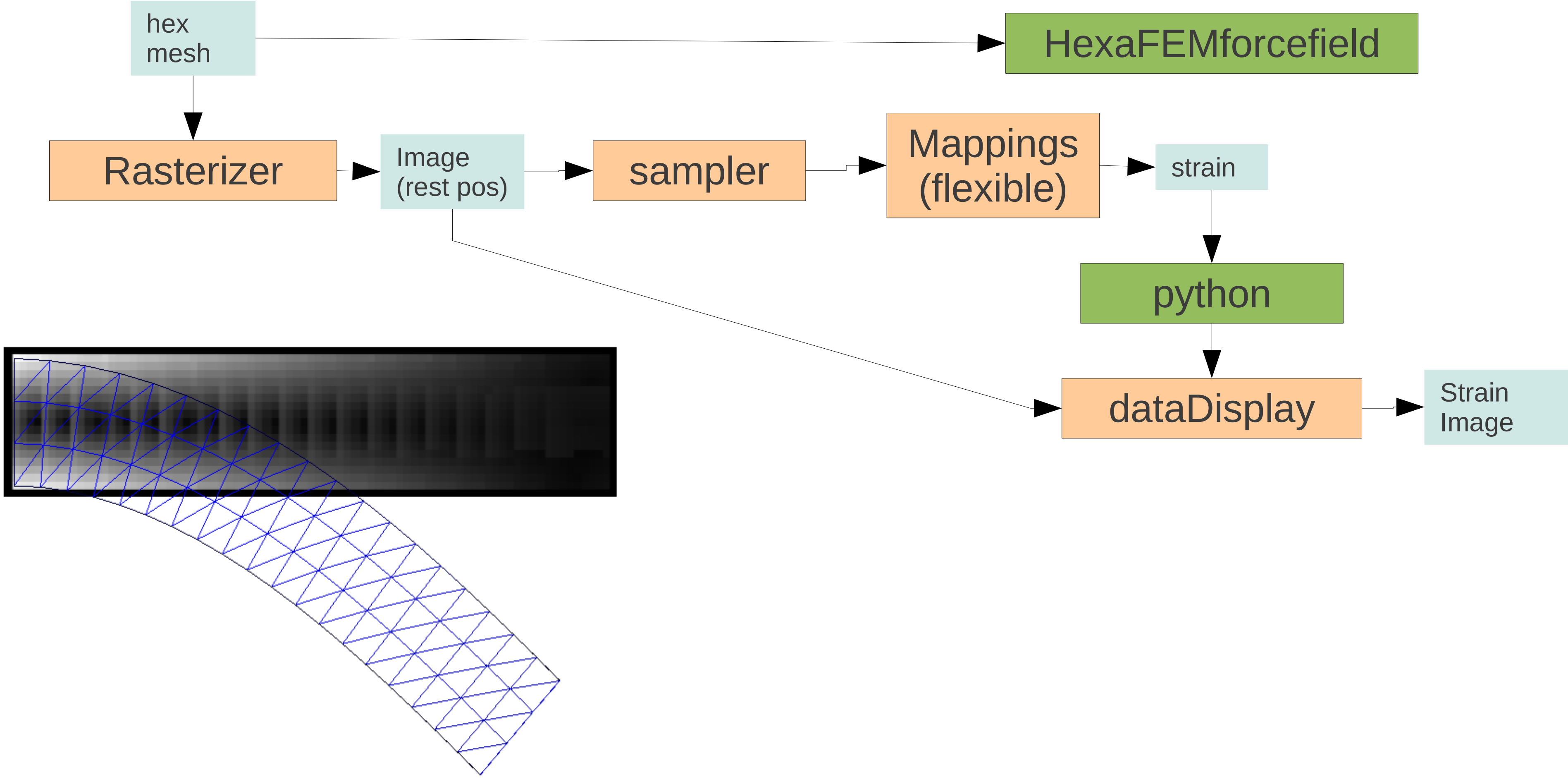
Surface mesh 2

isovalue2



Visualization of volumetric data

Flexible/demos/strainDiscretizer.scn



Video streaming

testCam.scn

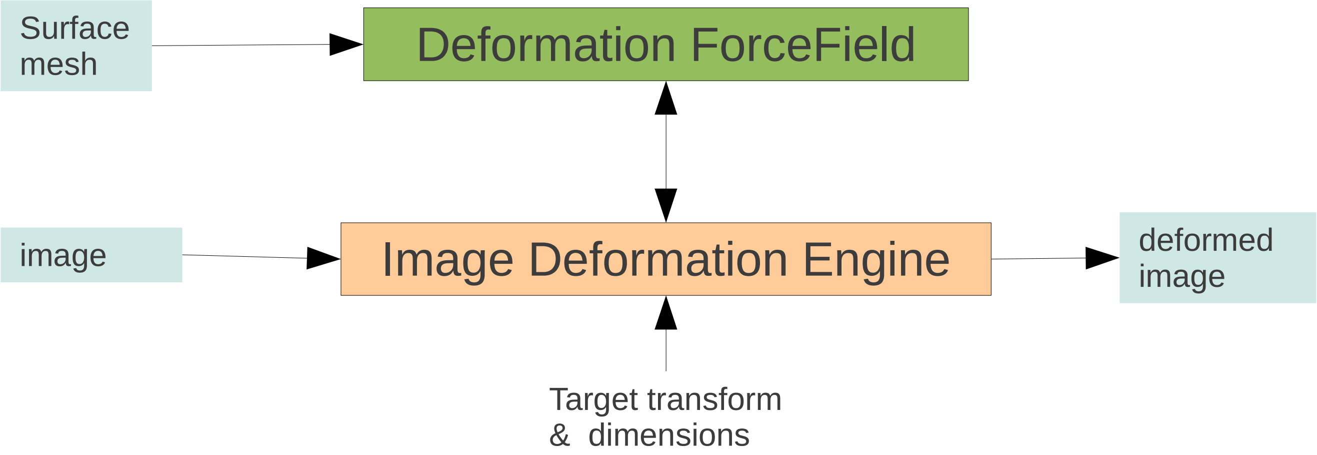
- Opencv camera
- ImageAccumulator : creates 4d+t data and handles synchro

kinect.scn

- Kinect + depthMapToMeshEngine
  - Mix simulation and 4d captures for validation, interaction, etc.

Image deformation

Flexible/deformation/imageDeformation.scn



Surface mesh

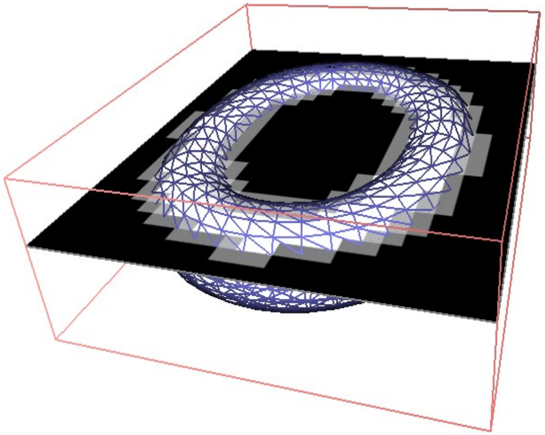
Deformation ForceField

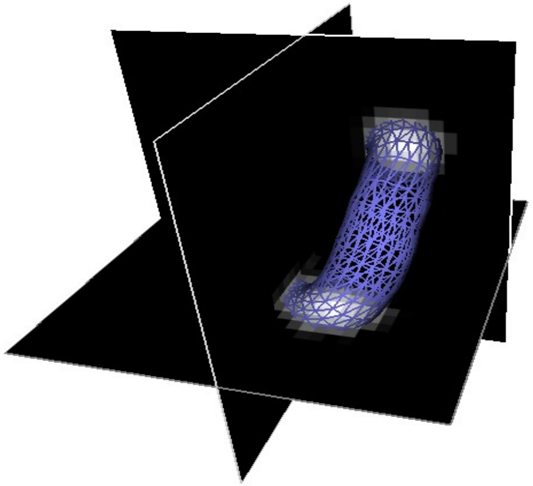
image

Image Deformation Engine

deformed image

Target transform & dimensions





Future work

- Volume rendering, simulation of X-ray images
- 2d/3d textures using image types
- Image based collision models
- Cutting
- More registration methods
- More transformations
- Deformation models in Eulerian setting
- Anisotropic materials