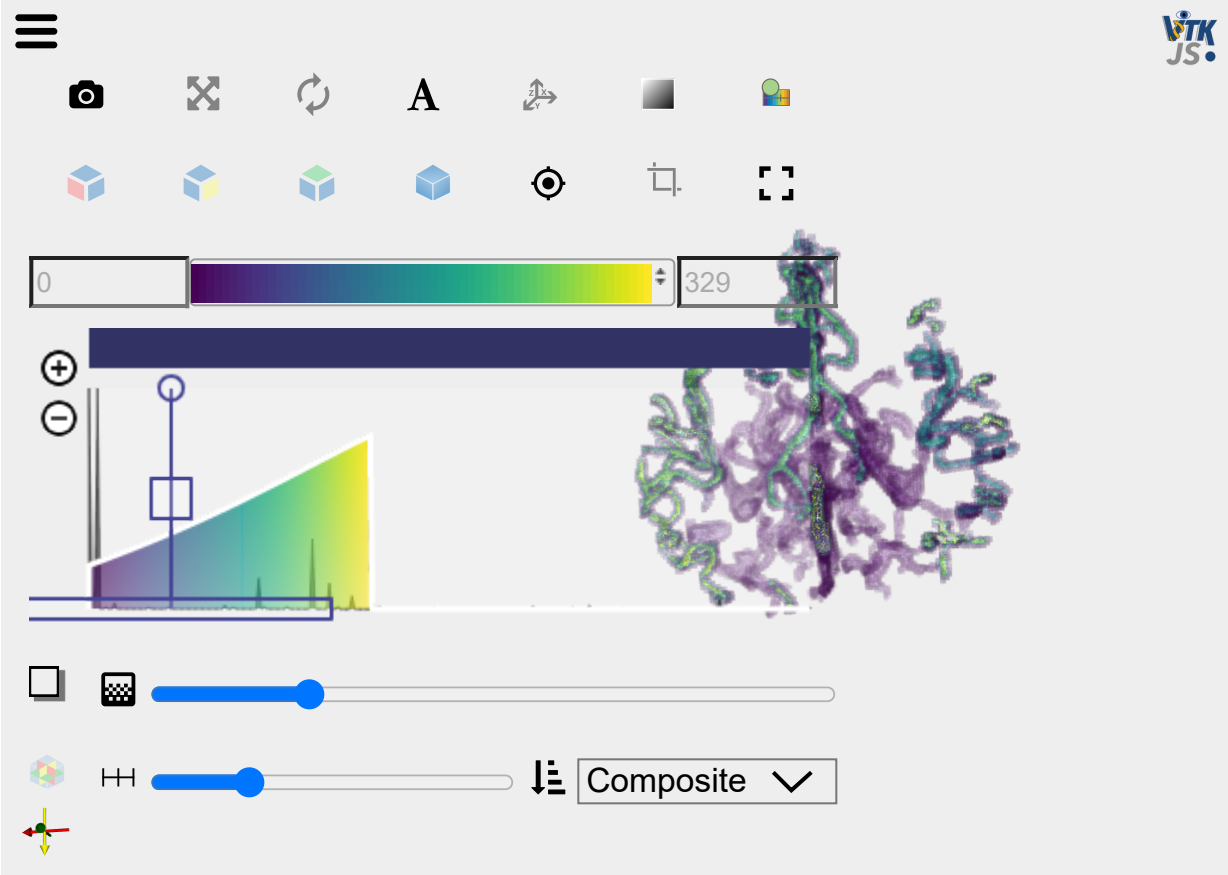
This notebook is intended to demonstrate how vessel segmentation methods of ITKTubeTK can be applied to multi-channel MRI (MRA + T1, T2, etc).

In [1]:
```
import itk
from itk import TubeTK as ttk

from itkwidgets import view

import numpy as np
```

In [2]:
```
ImageType = itk.Image[itk.F, 3]
dir = "../Data/CTA-Head/"
im1iso = itk.imread(dir + "CTA.mha")
im1BrainVess = itk.imread(dir + "CTA-Brain-VesselEnhanced.mha")
```

In [8]:
```
imMath = ttk.ImageMath.New(im1BrainVess)
imMath.MedianFilter(1)
imMath.Threshold(0.00000001, 1, 1, 0)
im1VessMask = imMath.GetOutputShort()

ccSeg = ttk.SegmentConnectedComponents.New(im1VessMask)
ccSeg.SetMinimumVolume(50)
ccSeg.Update()
im1VessMaskCC = ccSeg.GetOutput()
```

In [9]:
```
view(im1VessMaskCC)
```



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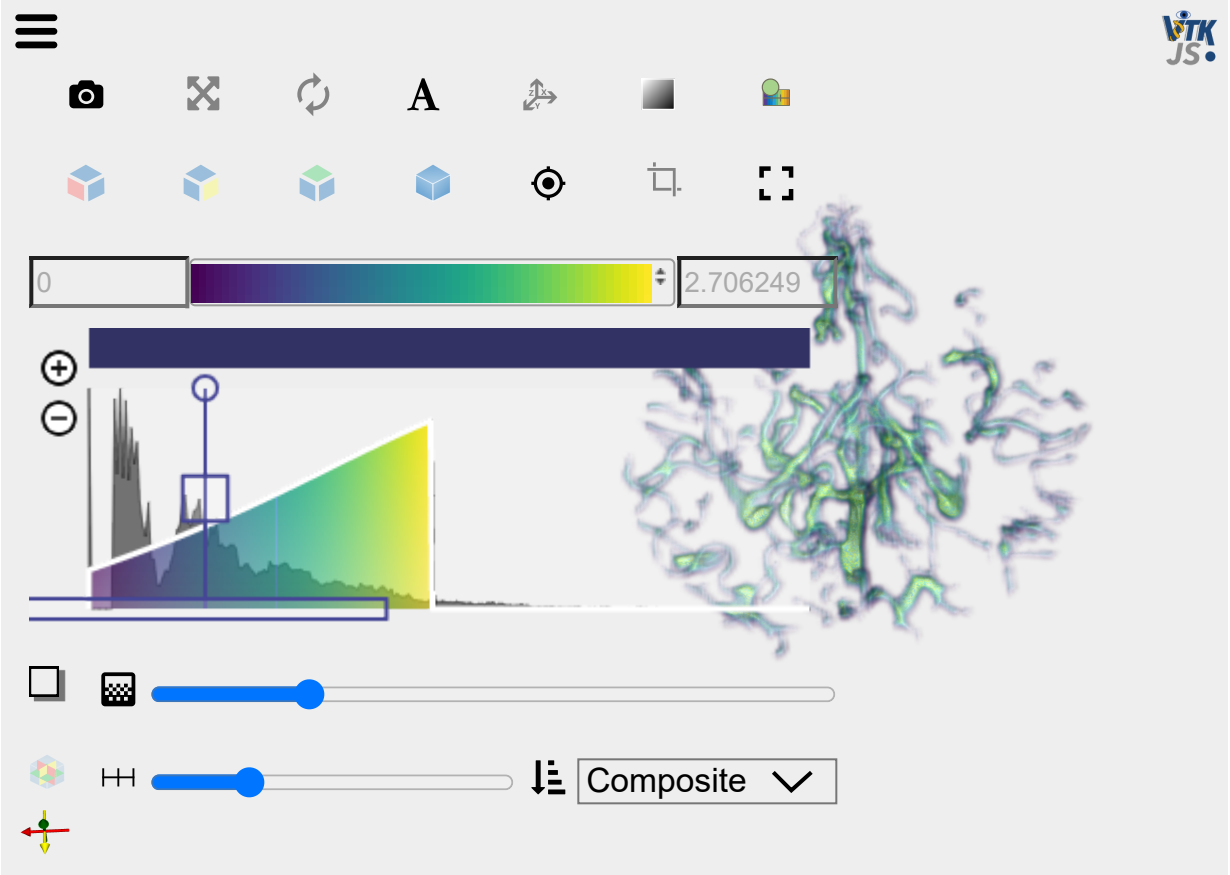
In [10]:
```
imMathSS = ttk.ImageMath.New(im1VessMaskCC)
imMathSS.Threshold(0,0,1,0)
im1VessMaskInv = imMathSS.GetOutputFloat()

distFilter = itk.DanielssonDistanceMapImageFilter.New(im1VessMaskInv)
distFilter.Update()
dist = distFilter.GetOutput()

imMath.SetInput(dist)
imMath.Blur(0.4)
tmp = imMath.GetOutput()
imMath.ReplaceValuesOutsideMaskRange(tmp, 0.1, 10, 0)
im1SeedRadius = imMath.GetOutput()

itk.imwrite(im1SeedRadius, dir+"CTA-VesselSeedRadius.mha")
```

In [11]:
```
view(im1SeedRadius)
```



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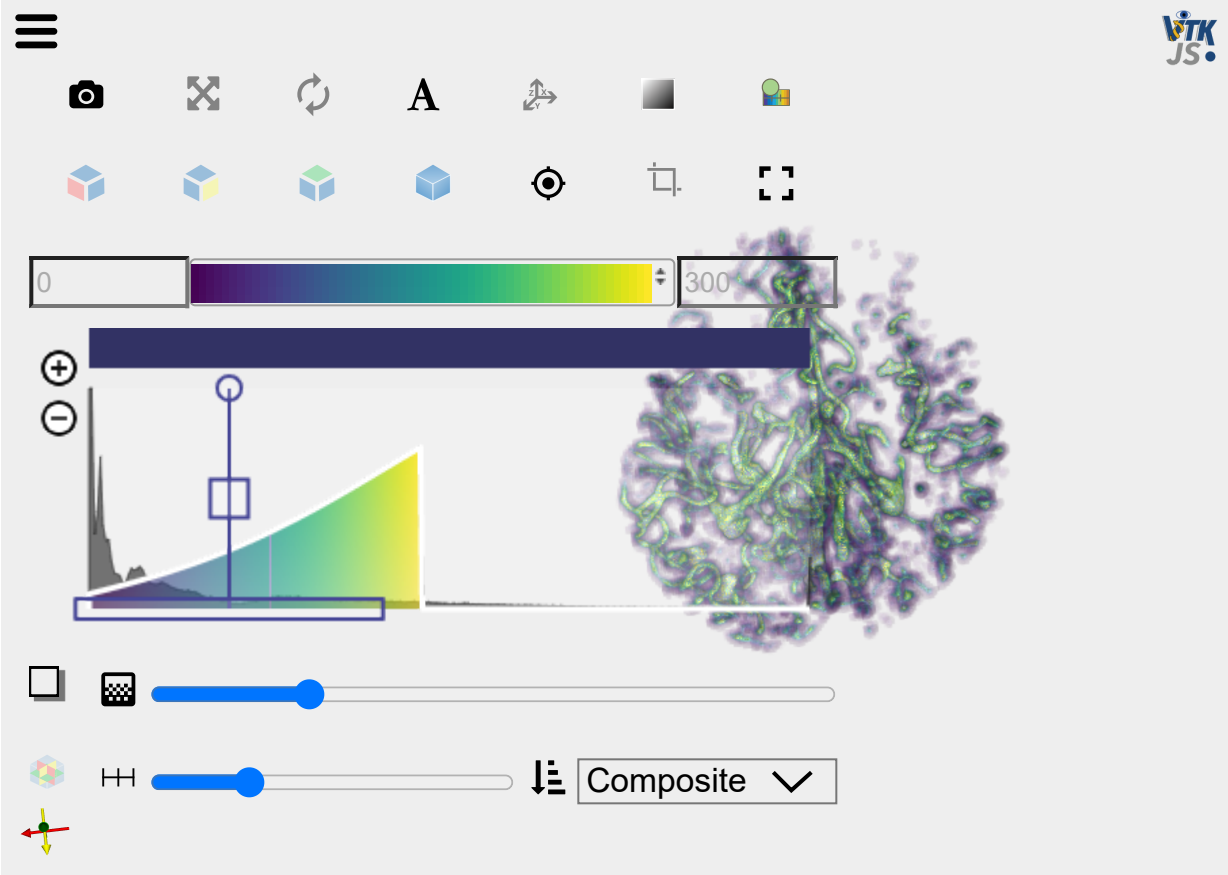
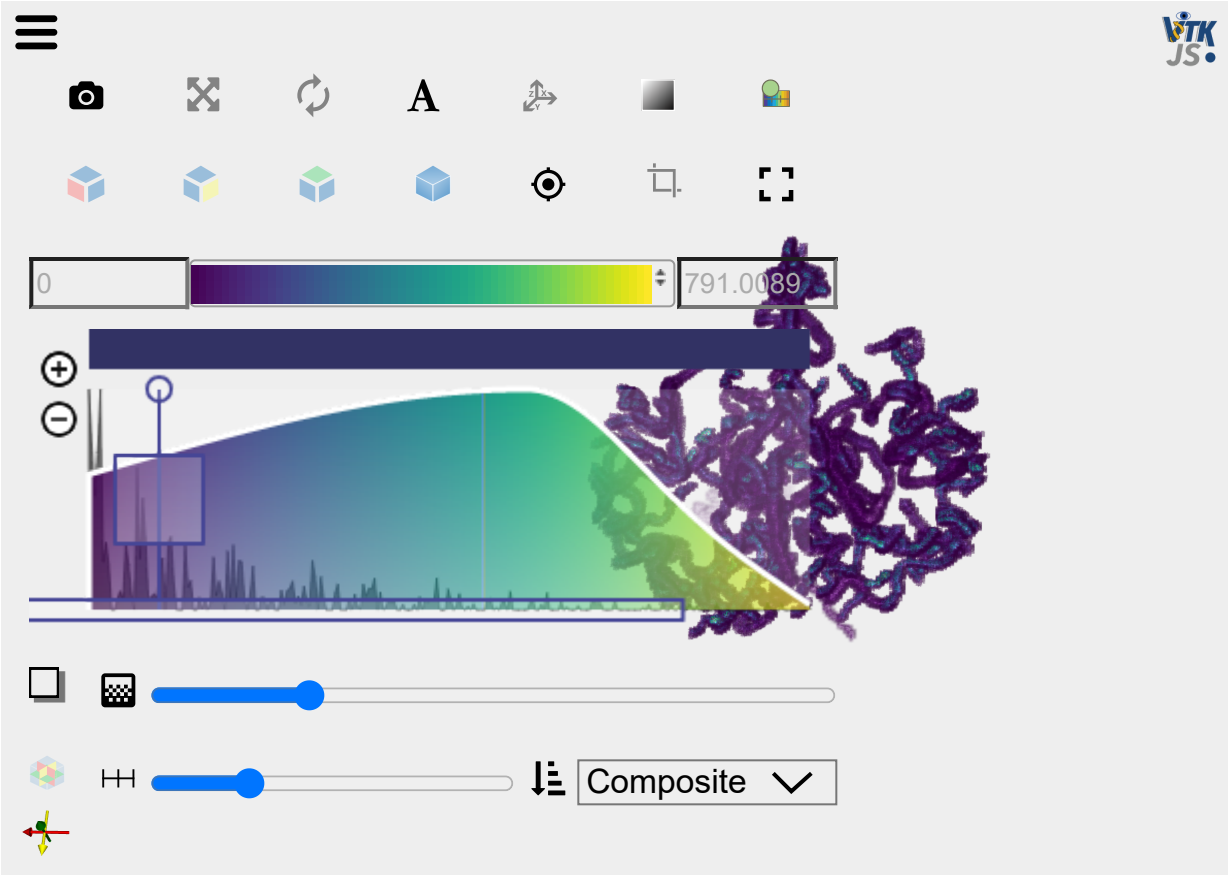
In [12]:
```
imMath.SetInput(im1iso)
imMath.ReplaceValuesOutsideMaskRange(im1BrainVess, 0, 1000, 0)
imMath.Blur(0.4)
imMath.IntensityWindow(0.5,300,0,300)
im1Input = imMath.GetOutput()

itk.imwrite(im1iso, dir+"CTA-VesselsInput.mha")

view(im1Input)
```



In [13]:
```
numSeeds = 40

vSeg = ttk.SegmentTubes.New(Input=im1Input)
#vSeg.SetVerbose(True)
vSeg.SetMinCurvature(0)#.0001)
vSeg.SetMinRoundness(0.02)
vSeg.SetMinRidgeness(0.5)
vSeg.SetMinLevelness(0.0)
vSeg.SetRadiusInObjectSpace( 0.8 )
vSeg.SetBorderInIndexSpace(3)
vSeg.SetSeedMask( im1SeedRadius )
#vSeg.SetSeedRadiusMask( im1SeedRadius )
vSeg.SetOptimizeRadius(True)
vSeg.SetUseSeedMaskAsProbabilities(True)
vSeg.SetSeedExtractionMinimumProbability(0.4)
#vSeg.SetSeedMaskMaximumNumberOfPoints( numSeeds )
vSeg.ProcessSeeds()
```

In [14]:
```
tubeMaskImage = vSeg.GetTubeMaskImage()
view(tubeMaskImage)
```



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In [15]:
```
SOWriter = itk.SpatialObjectWriter[3].New()
SOWriter.SetInput(vSeg.GetTubeGroup())
SOWriter.SetBinaryPoints(True)
SOWriter.SetFileName( dir+"CTA-Vessels.tre" )
SOWriter.Update()
```

In [16]:
```
VTPWriter = itk.WriteTubesAsPolyData.New()
VTPWriter.SetInput(vSeg.GetTubeGroup())
VTPWriter.SetFileName(dir+"CTA-Vessels.vtp")
VTPWriter.Update()
```

In [ ]:
```

```