Intervertebral Disc Segmentation Using Mathematical Morphology

A CNN-free approach!

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IVDM3Seg MICCAI 2018

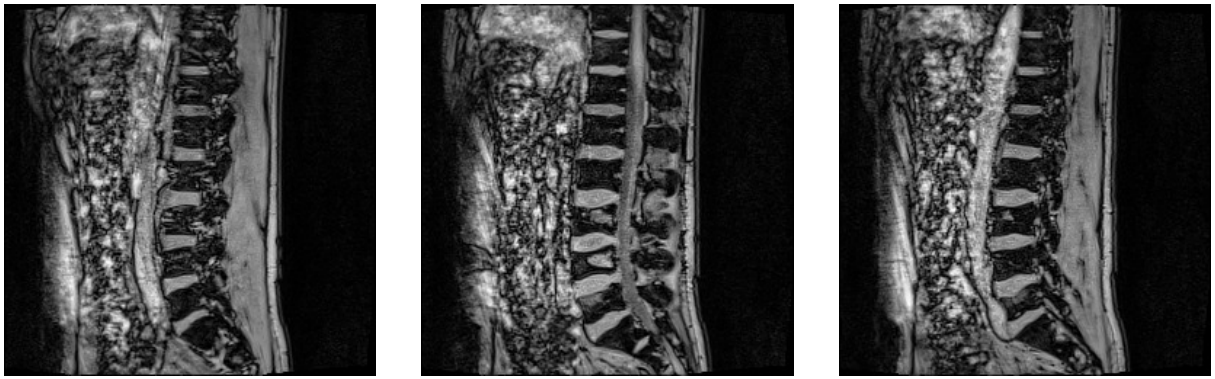
Overview

Steps:

1. preparing a 2D image
2. obtaining markers
3. tree-based segmentation
4. cleaning

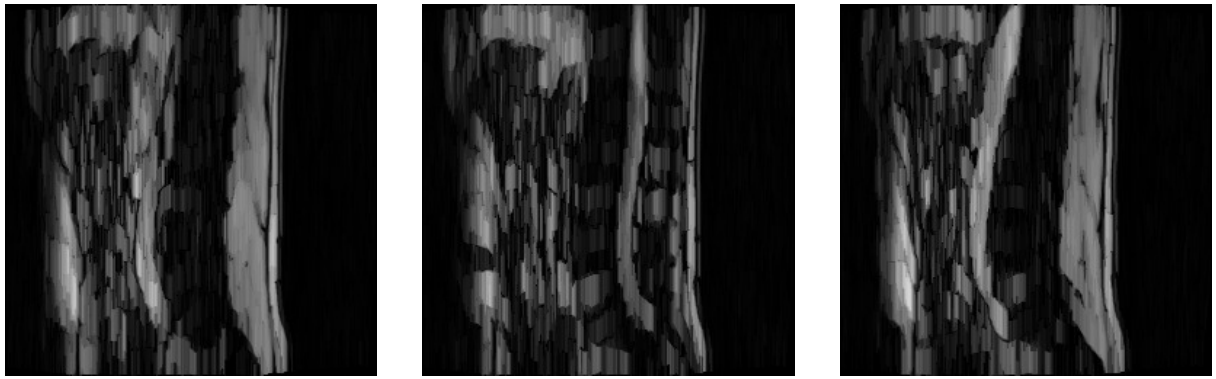
using prior knowledge about IVD contrast, geometry, and localization

Data



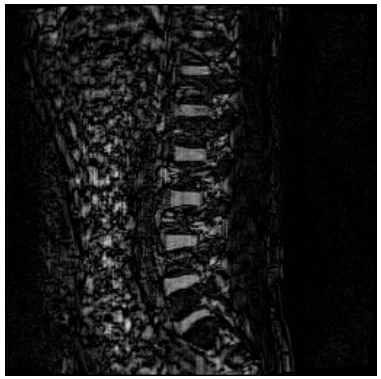
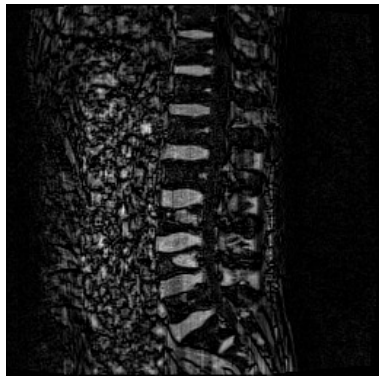
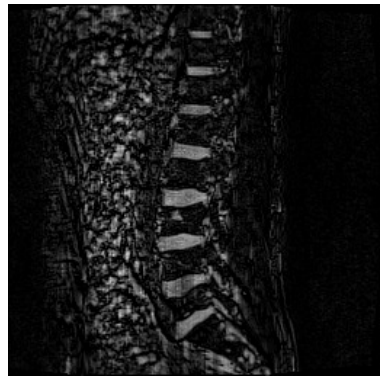
opp slices at $z = 8, 16, 24$

Step 1



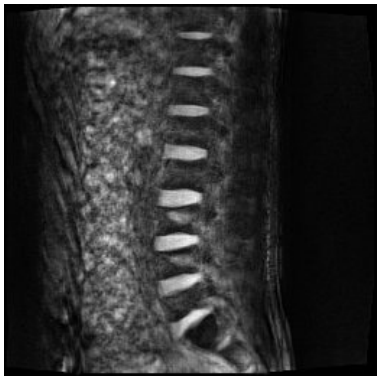
morphological opening with a vertical structuring element

Step 1

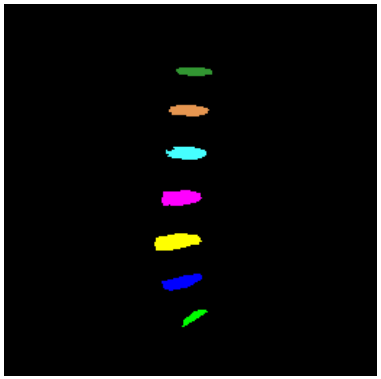
residue (diff btw input and output) = *top-hat*

Step 1



summation of all slices of residues = a 2D image

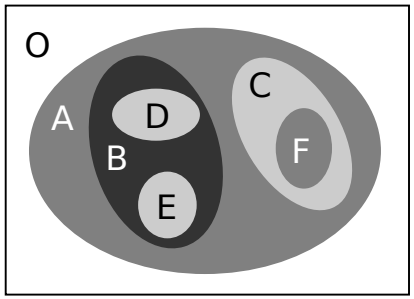
Step 2



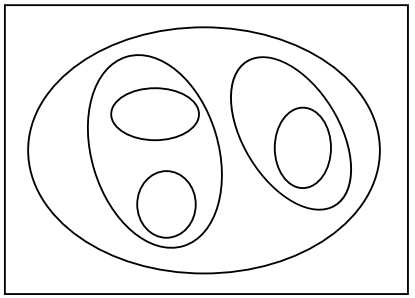
2D markers obtained using a morphological tree [...]

Morphological Tree of Shapes (ToS)

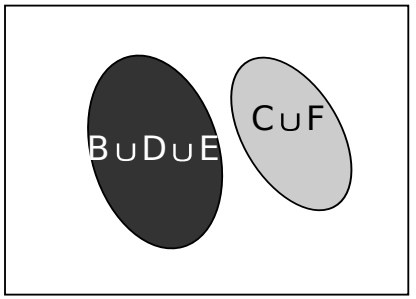
ToS = tree of inclusion of the level lines



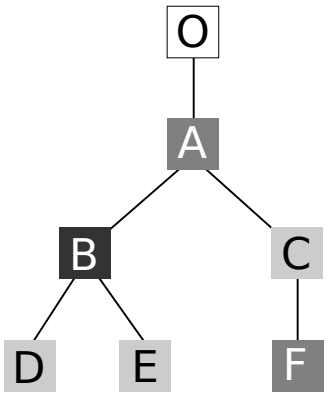
f



level lines of f

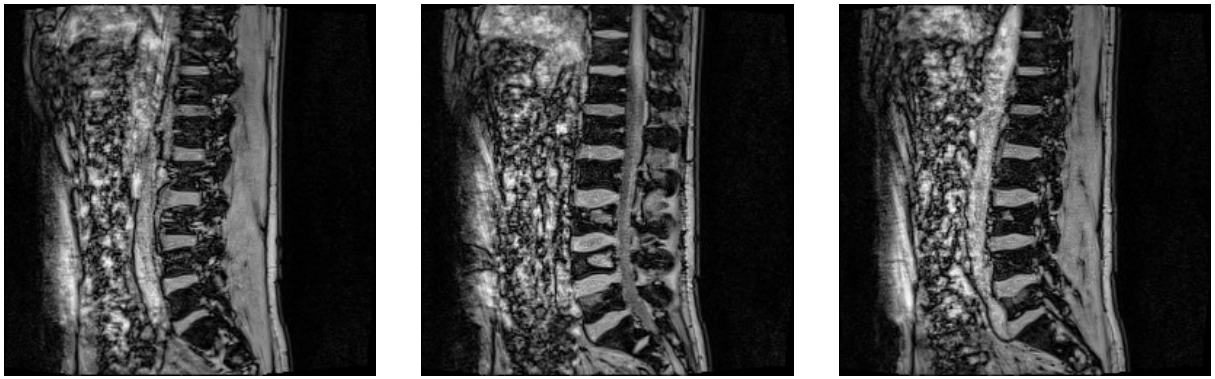


two shapes of f



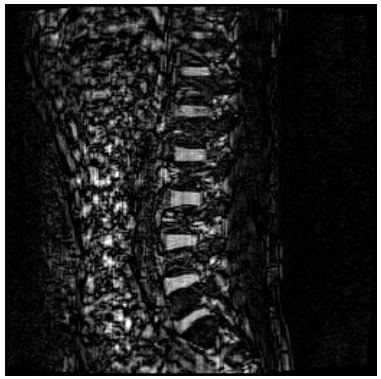
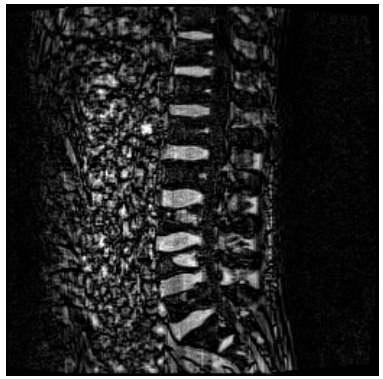
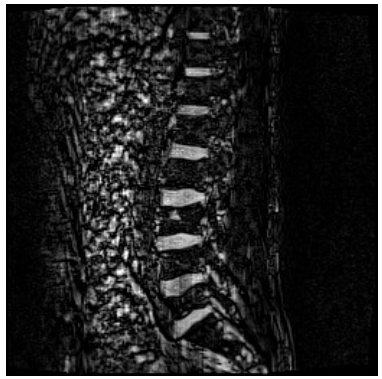
ToS(f)

Data



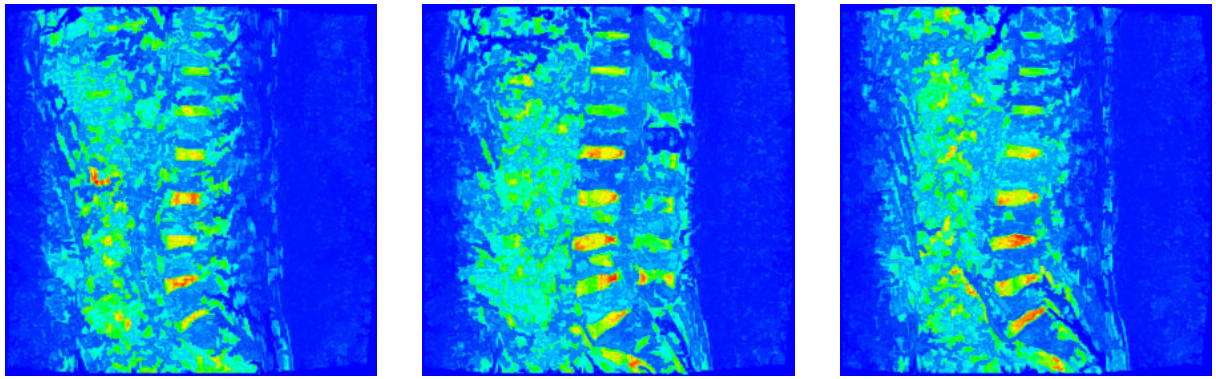
opp slices at $z = 8, 16, 24$

Step 3

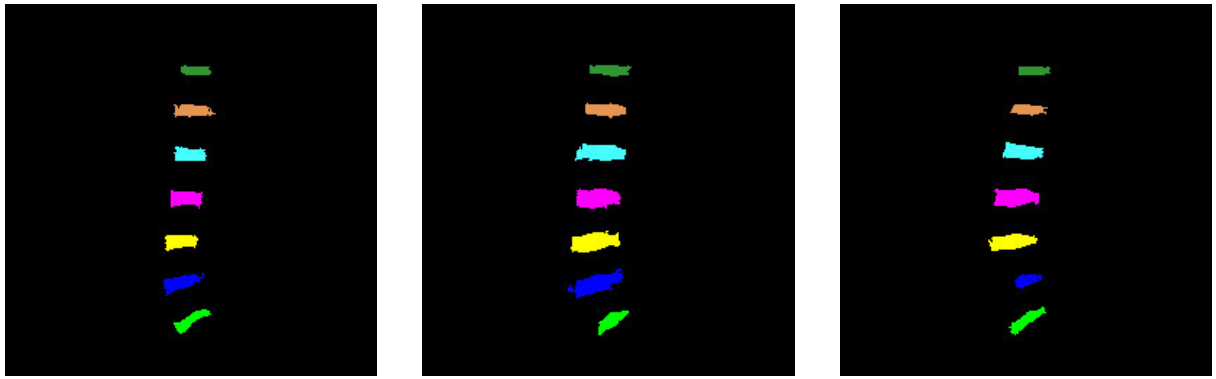
3D input = *top-hat*(opp) + *top-hat*(wat) - fat

Step 3



depth of pixels in the tree of shapes (computed on each slice)

Step 3



“best” nodes in the tree of shapes before cleaning (step 4)

Last slide

Conclusion:

- use of mathematical morphology
  (the tree of shapes is often well suited for segmentation tasks in medical imaging...)
- a solution developed in about 10 man-days
- average running time for one volume = 2.33 s
- deep learning & CNN are not always the only way!
- see you for more info in front of our poster; you're welcome...

we're evangelists with the holy church of mathematical morphology