

# Automatic Segmentation of Lumbar Spine 3D MRI Using Ensemble of 2D Algorithms.

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# Background

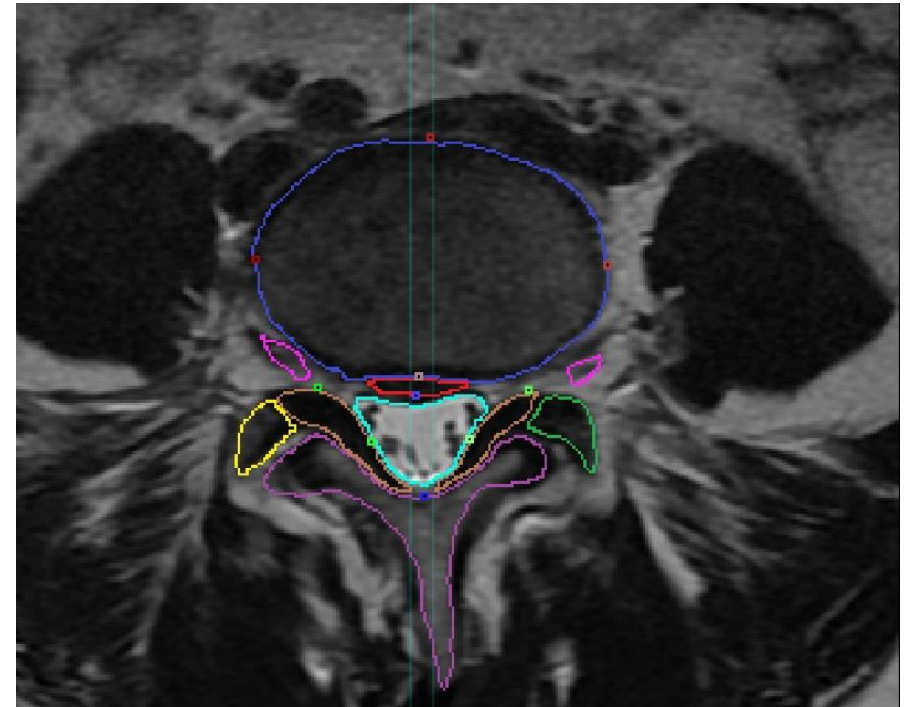
Working on a project for detecting lower back pathologies:

- Using CNN for segmentation and classification of different tissues.
- Using segmentation to measure abnormalities.
- Diagnosis

Developing our own dataset.

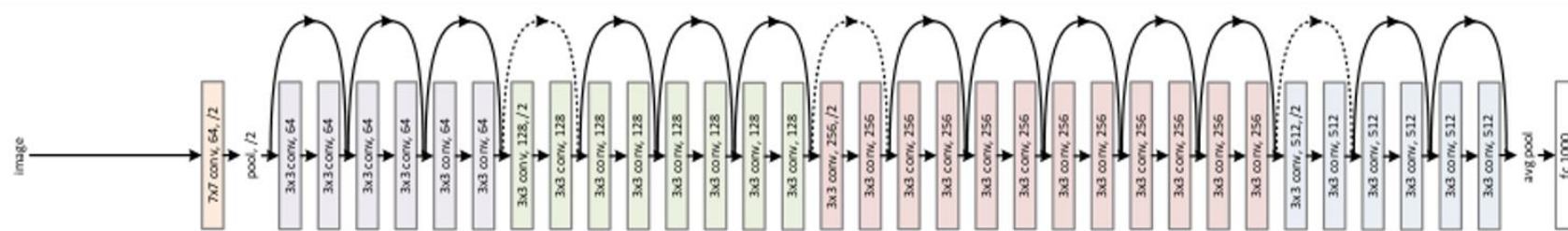
MRI protocols we have used so far :

- Series of 2D images.
- Not perpendicular to each other.
- Axial slices are parallel to the Disc plane
- Not uniformly spaced in the volume.



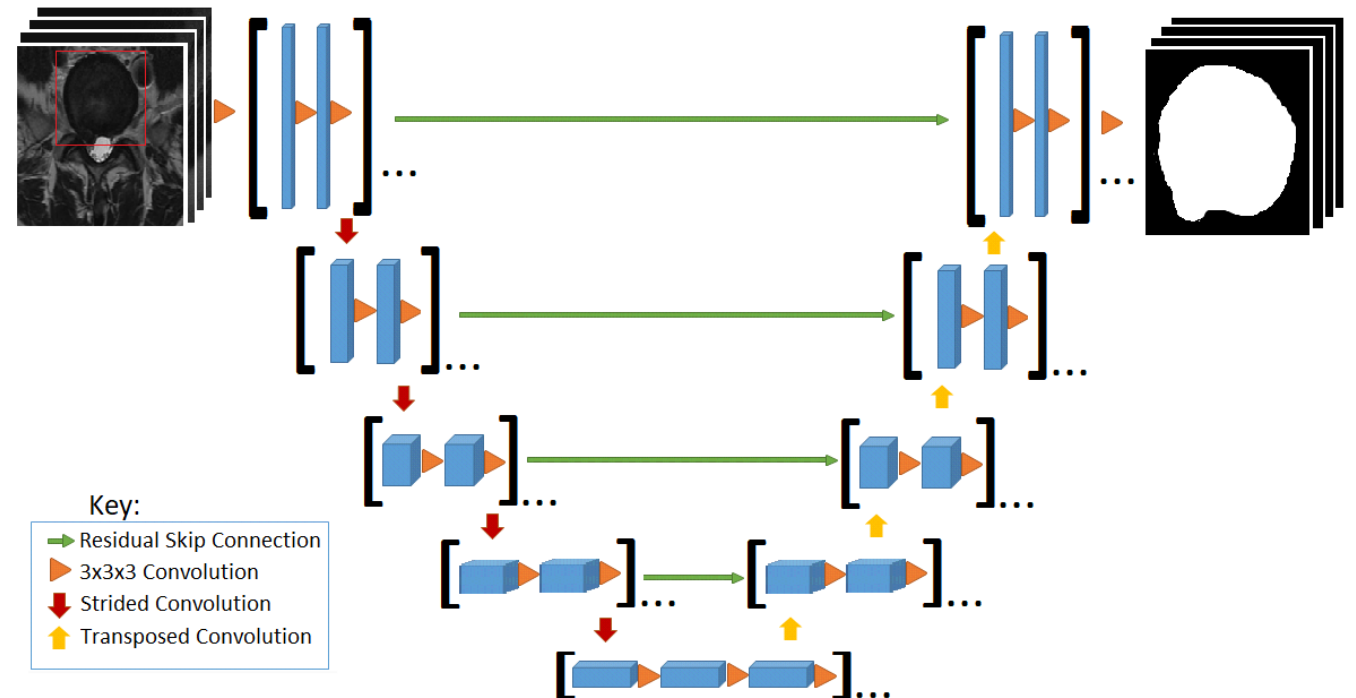
# Segmentation 2D

- Fully convolutional ResNet for feature map extractor.
- From Image(512x512x3) to feature map(64x64x1024)
- Transfer learning



# Segmentation 2D

- Mask prediction network, similar to U-Net.
- Use different feature extractor depths and resolutions for the up convolutions in mask prediction.



# Segmentation 3D

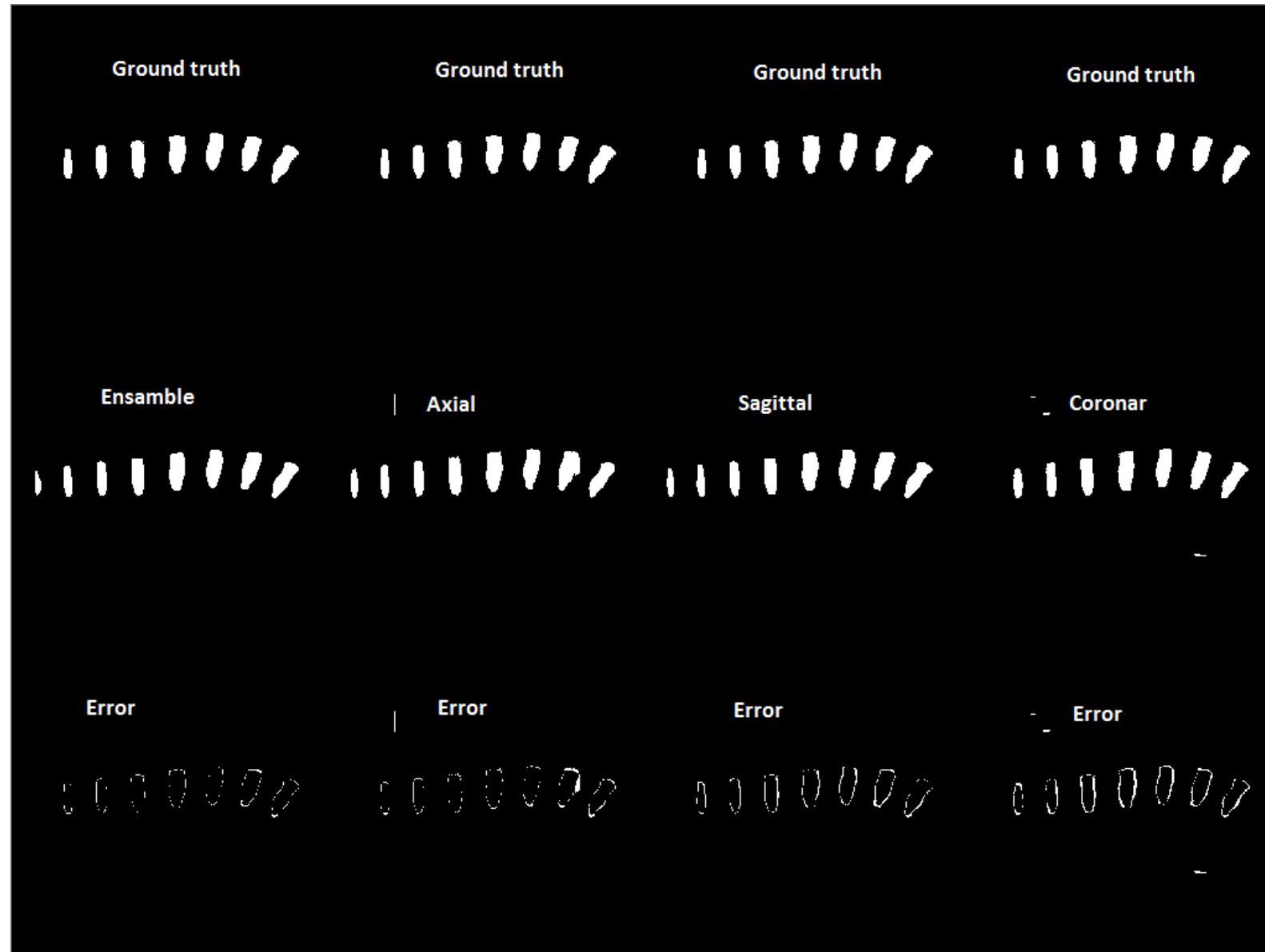
- Cut 3D MRI data into 3 perpendicular series of 2d images: Axial, Sagittal, Coronal
- Predict 2D mask probabilities.
- 3 channel 3D map. (each plane mask probabilities assembled back in 3D)
- Combine all voxels with 3D convolution to output 1 channel voxels.
- Separate model with around 50 parameters , trained on the validation set , left from the previous stage.

# 3D ensemble

Performance of each plane:

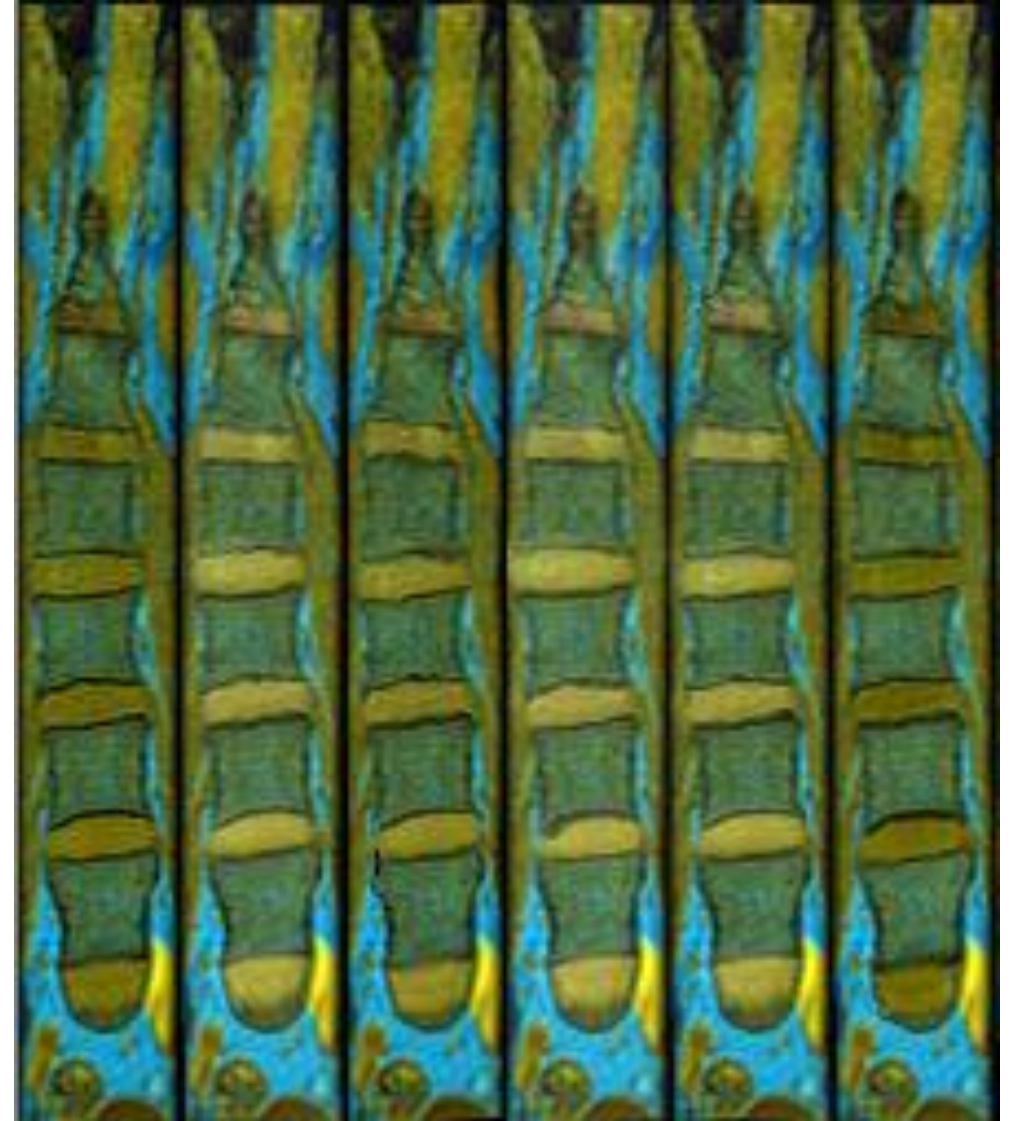
2D planes used	Mean DICE
Sagittal	0.84
Axial	0.87
Coronal	0.74
Ensemble	0.92

The ensemble combines the strengths of the 3 planes. Each plane is accurate in different regions of the disk.



# Data augmentation

- Elastic whole image deformation
- Tissue deformation
- Tissue brightness
- Noise



# Thank you

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