An Encoder-Decoder Deep Neural Network for Binary Segmentation of Seismic Facies

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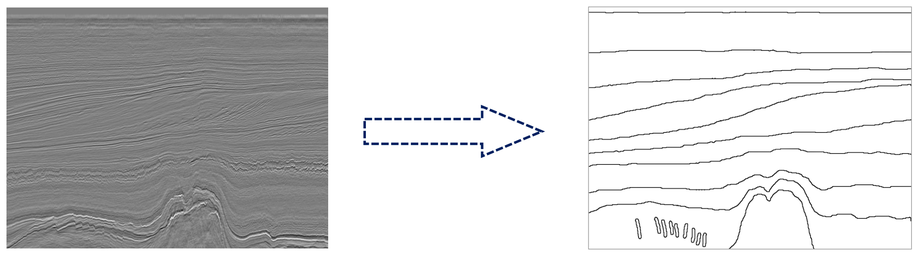
IN A NUTSHELL

- A deep neural network that outperforms state-of-the-art methods with fewer parameters
- A composite loss function that linearly combines cross-entropy and Jaccard loss
- Fast segmentation of an arbitrary number of seismic facies
- A seismic facies dataset for binary segmentation

SEISMIC FACIES GEOMETRY SEGMENTATION PROBLEM

- Manually identify seismic facies geometries is a time-consuming and arduous task to be performed
- There are GigaBytes of seismic data to be analyzed
- Seismic datasets are scarce and need a specialized professional for their creation
- How to segment an arbitrary number of seismic facies geometries using neural networks?



- Using only the cross-entropy loss function is not enough to obtain detailed segmentation of seismic facies geometries identify

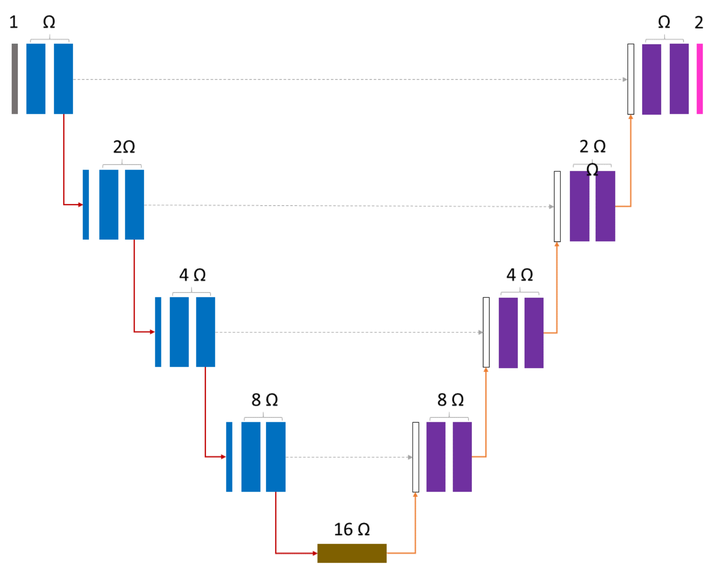
PROPOSED METHOD

- Proposed an encoder-decoder **Deep neural network for facies segmentation** (DNFS) compared with StNet and U-Net variants to find a minimum neural network
- Creation of a binary dataset in which black lines represented the transition of seismic facies geometry
- **Composite loss function** by the linear combination of **cross-entropy** and **Jaccard loss**

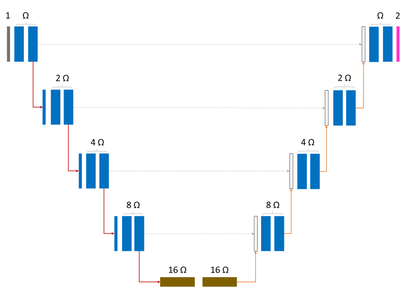
$$Loss = (1-\eta)CrossEntropy_l(A,B) + \eta\, JaccardLoss(A,B)$$

- Five experiments were performed to find the (η) composite loss function coefficient.
- Neural network total number of parameter variations by factors (Ω): 4, **8**, 16, 32, 64, 128

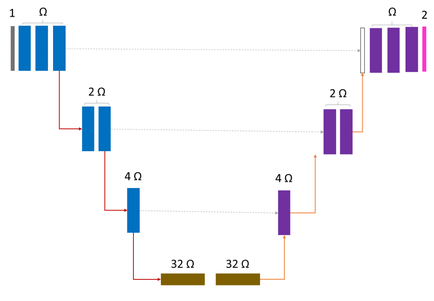
SCHEME FOR VARIATION OF THE TOTAL NUMBER OF PARAMETERS



Deep neural network for facies segmentation (DNFS)



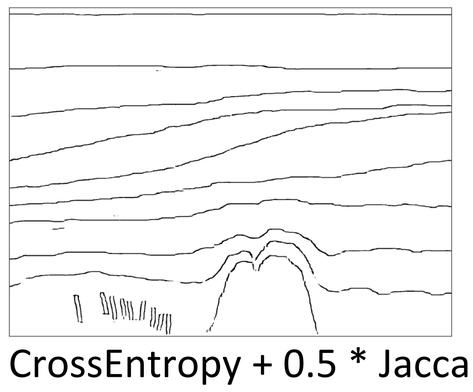
U-Net



StNet

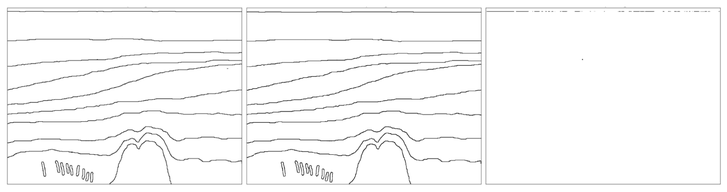
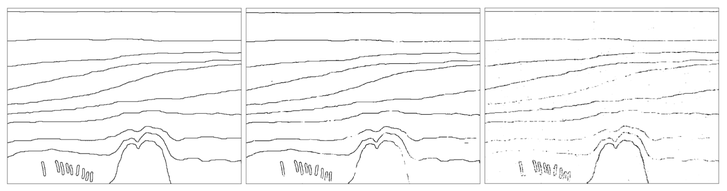
EXPERIMENTAL RESULTS

- Composite loss function coefficient (η) chosen value: 0.5



0.5 * CrossEntropy + 0.5 * JaccardLoss

- Examples of predictions with factors (Ω) **8** and 64

Factor	DNFS	U-Net	StNet
8			
64			

- DNFS has high accuracy than StNet and U-Net, and it was trained in about 15 minutes
- DNFS (with factor 8) has approximately 0.3 million parameters and occupies 3 megabytes on disk