ML Segmentation Models to Automatically Identify Areas Affected by Earthquakes

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Abstract

Some studies have been applying ML's ability to detect InSAR images with the fringes in InSAR images; however, no studies have been found where the area is isolated using segmentation techniques. In this work we apply segmentation models to identify areas affected by earthquakes in InSAR interferograms.

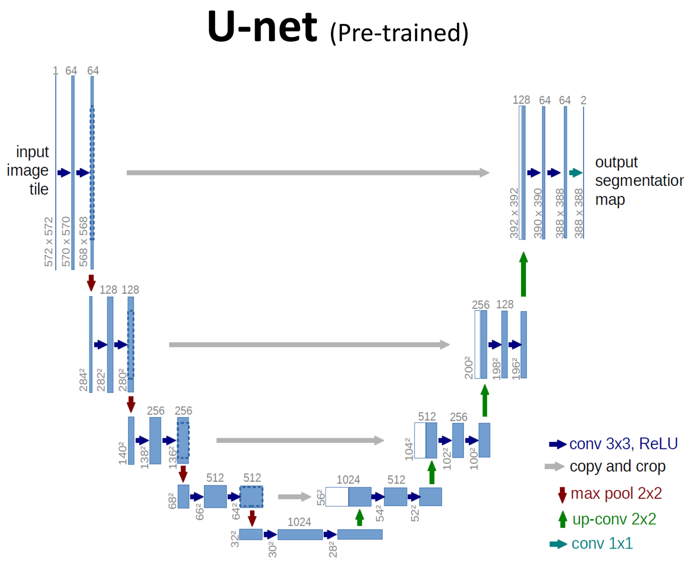
Introduction

To train deep learning models first is needed to prepare the data that will be the input. The data will pass for the layers, and it gives a response (in the first time it will be a random one), then it will be a comparison between the response given for the algorithm and the real response given by us (on the input), the difference of them will be the loss score. In the end, this score will be used as a feedback signal to adjust the value of the weights of the layers.

For the segmentation, the input will be the interferogram and the mask created by us, in the output we will have the segmentation predicted by the model.

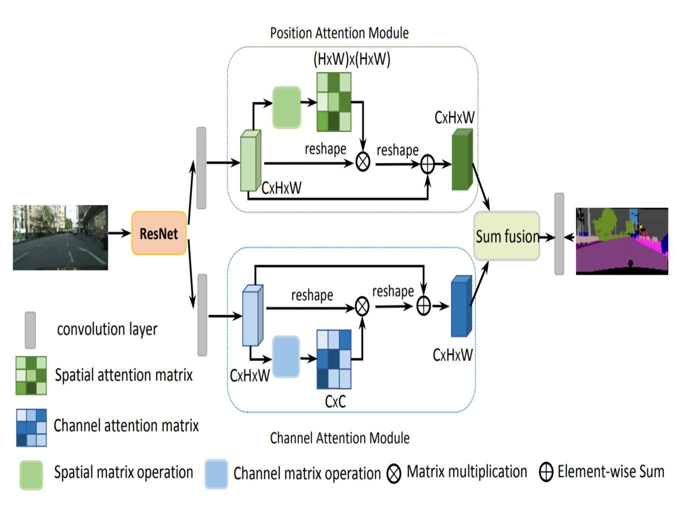
Used thechniques:

U-net (Pre-trained)



Reference: Weng & Zhu, UNet: Convolutional Networks for Biomedical Image Segmentation ,2021

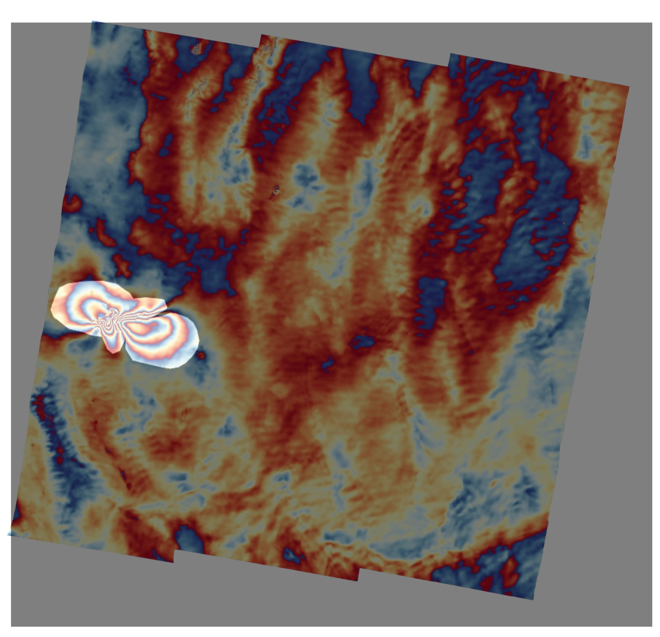
Dual attention



Reference: Fu et al., Dual attention network for scene segmentation, 2019

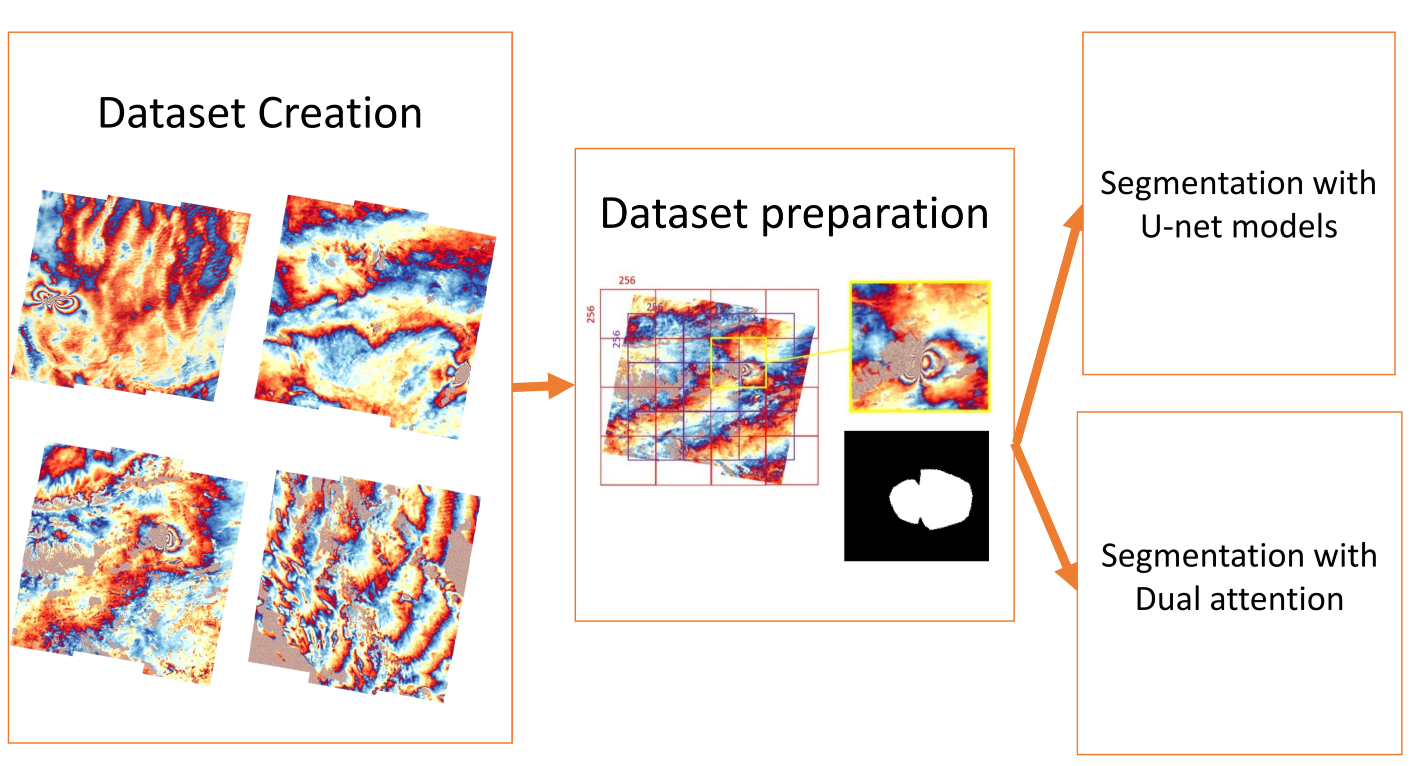
Objective

In this poster we test two techniques to segment the area affected by earthquakes In wrapped interferograms without any type of atmospheric correction.



Methods

We start this work creating a InSAR dataset with 469 interferograms from 29 earthquake cases between 2019 and 2021 and create a mask for each of them. We create the mask with a margin to test if the model can detect deformation that cant be seen due to the atmospheric error. we then cut the images into 256x256pixels overlapped and choose the ones with fringe. Finally we use the patches to train 3 pre-trained U-net models and a dual attention model.



Dataset

	Train	Validation	Test
Earthquake fringes (deformation)	499	380	252

Models evaluation

First test with 50% treshold

	Model	IoU Score	Dice Score	Accuracy
U-net	**InceptionV3**	0.43	0.59	0.83
	VGG19	0.32	0.47	0.85
	Resnet50	0.13	0.22	0.80
Dual attention	**Resnet50**	0.25	0.39	0.84

Only U-net InceptionV3 and U-net VGG19 shows promising results

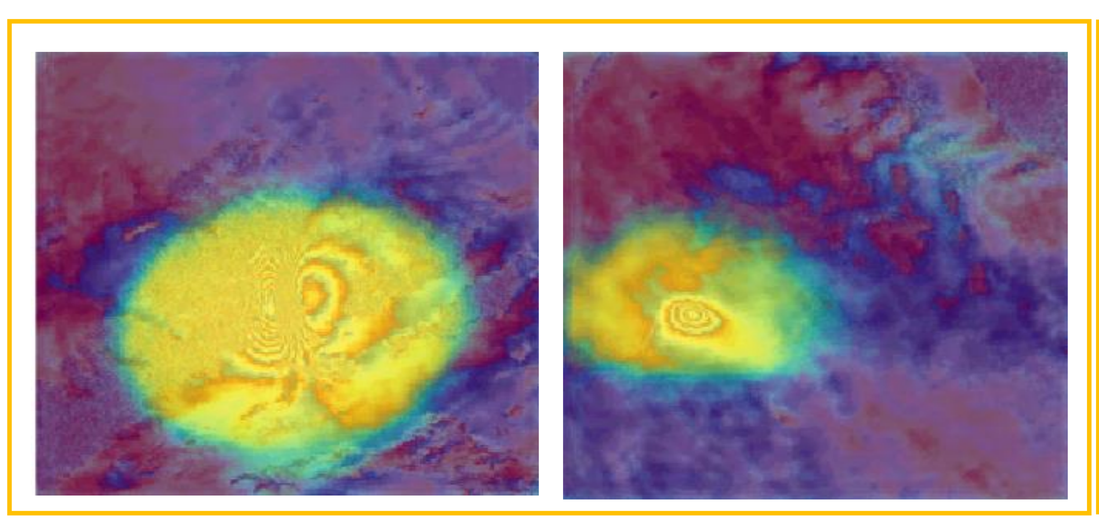
Finding the best threshold on train set for this two models

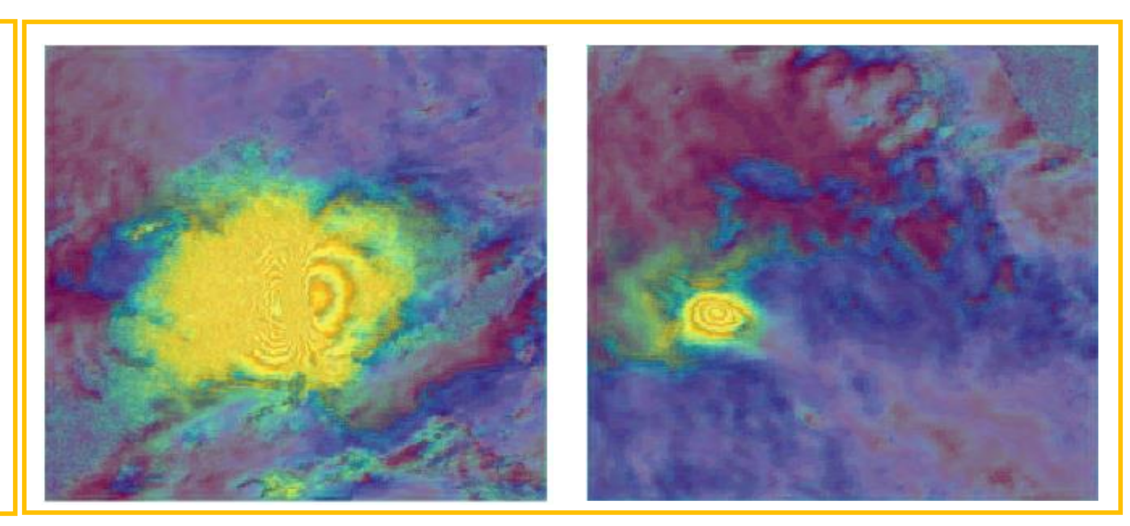
90% for InceptionV3 and 70% for VGG19

Model	IoU Score	Dice Score	Accuracy
InceptionV3	0.48	0.63	0.87
VGG19	0.47	0.62	0.85

InceptionV3
can found fringes but is not good to detect margins

VGG19
better find fringes and margins but interpret noise as fringes





Conclusion

1. We successful create two InSAR datasets.
2. VGG19 and InceptionV3 for U-Net model were the best models to segment earthquake deformation fringes.
3. Deep learning proves to be able to “see” deformation fringes and locate them.

5. This shows promising results but bigger dataset is needed to obtain the desire results.
6. An intersection of both U-net models (VGG19 and InceptionV3) will probably improve the results.

7. Dual attention had worse results then U-net, not being good for segment deformation fringes in InSAR interferograms.