Unbalanced Technics to Improve the Train for ML Models to Detect Earthquake Fringes

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Abstract

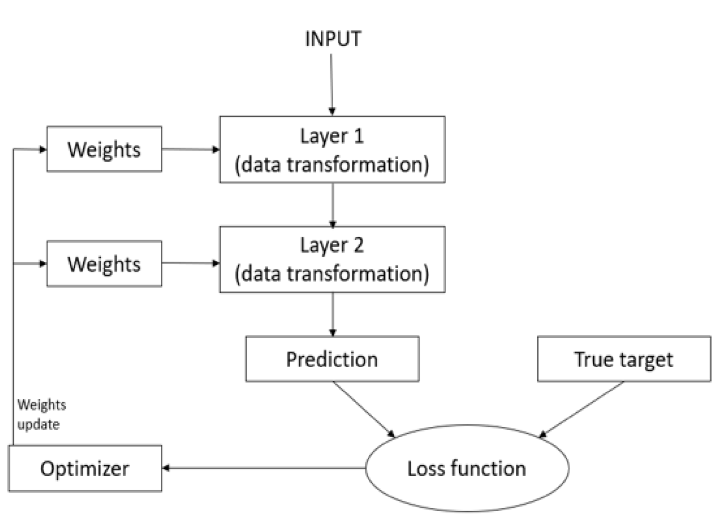
Machine Learning can automatically process large datasets in the most varied areas, including remote sensing data, and it has become an opportunity for earth observation. Recent studies have demonstrated the ability to detect visible fringes deformations in InSAR images. However, InSAR data is frequently unbalanced - deformations are sparse compared to those that do not have deformation, and it needs special attention for training ML models.

In this work, we created two InSAR datasets with 29 earthquake cases from the LICS database. At start we use Data Augmentation to deal with data unbalanced to detect fringes, but when the data grew, and the unbalancing got bigger DA start to perform worse, so we apply a new technique to deal with the unbalancing.

Introduction

Train deep learning models

1. prepare the input data
2. The data will pass for the layers, resulting a prediction
3. Prediction are evaluated through loss function resultin a score.
4. The score is used as feedback to adjust model weights throught the optimizer.

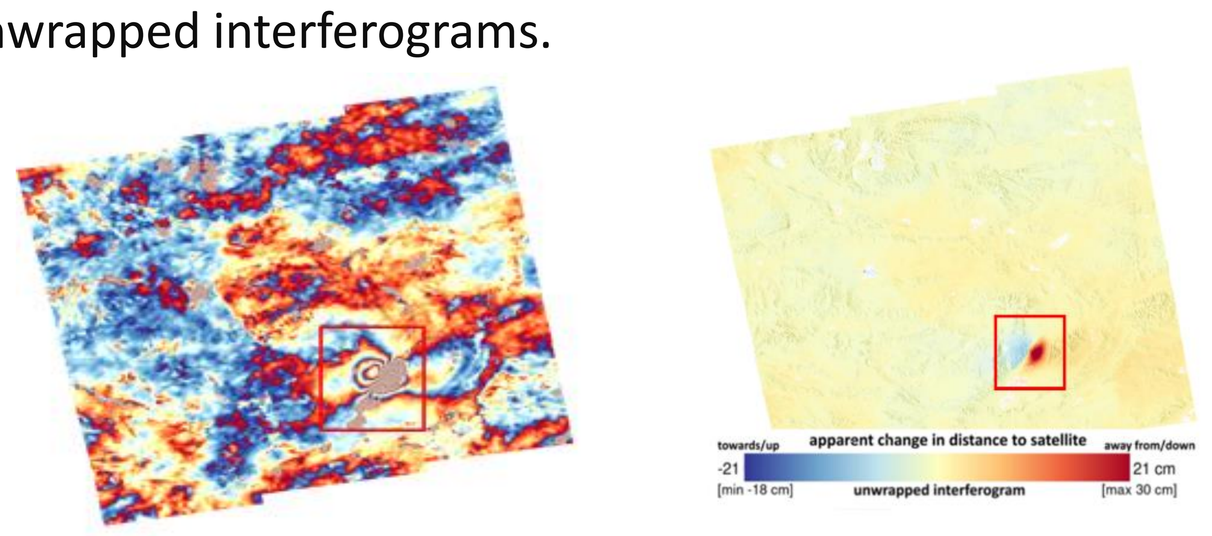


Focal Loss compensate data less represented.

Data augmentation creates artificial data with small alteration, to balance the data in the same amount.

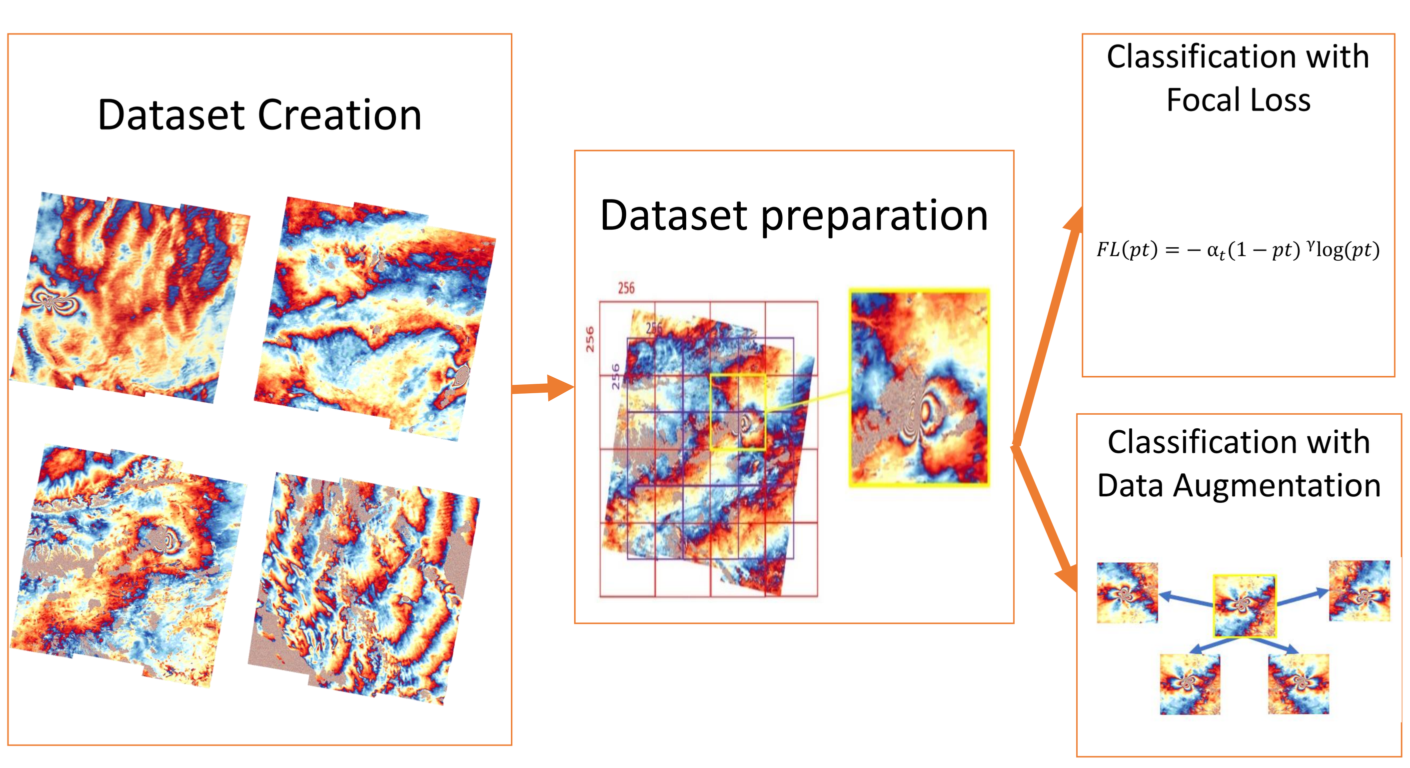
Objective

Deal with unbalanced data training deep learning models to identify deformation in InSAR images, both is wrapped and unwrapped interferograms.



Methods

Two dataset of InSAR interferograms were created (wrapped and unwrapped). We cut images into 256x256pixels overlapped patches. Finally we use the patches to train 3 pre-trained models with focal loss and we use the best model to compare focal loss with data augmentation.

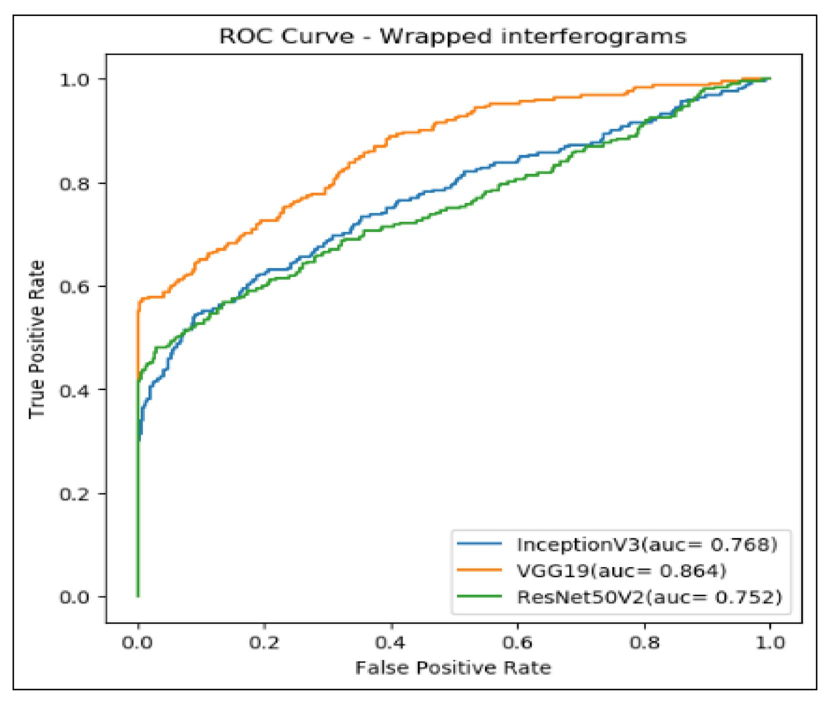


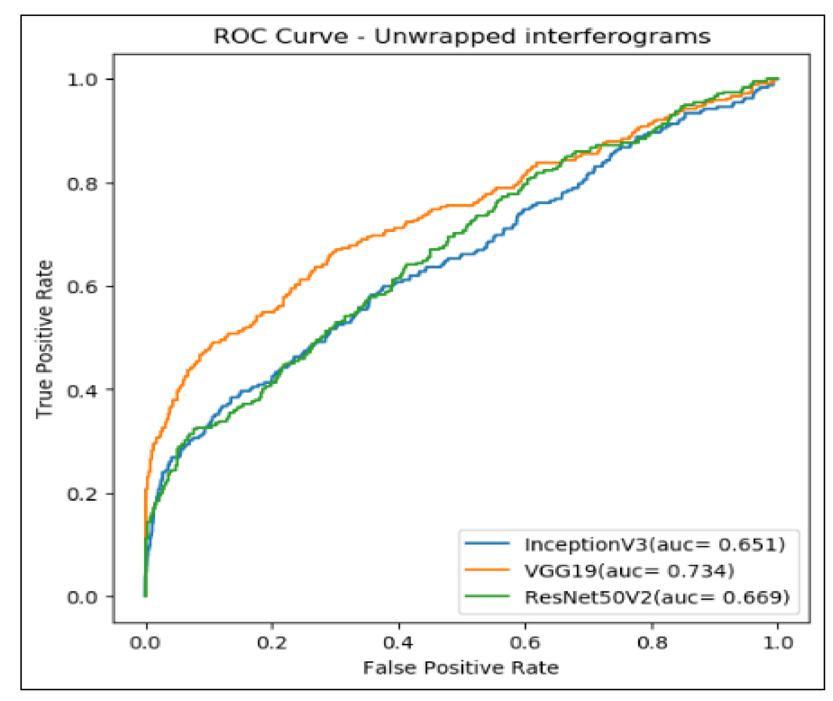
Dataset

	Train	Validation	Test
Earthquake fringes (deformation)	499	380	252
No deformation	14979	4051	3826

Models evaluation

	Wrapped interferograms			Unwrapped interferograms		
Models	Accuracy	F1 Score	AUC	Accuracy	F1 Score	AUC
InceptionV3	0.952	0.371	0.768	0.938	0.137	0.651
VGG19	0.971	0.691	0.864	0.951	0.330	0.734
Resnet50V2	0. 960	0.526	0.752	0.943	0.160	0.669

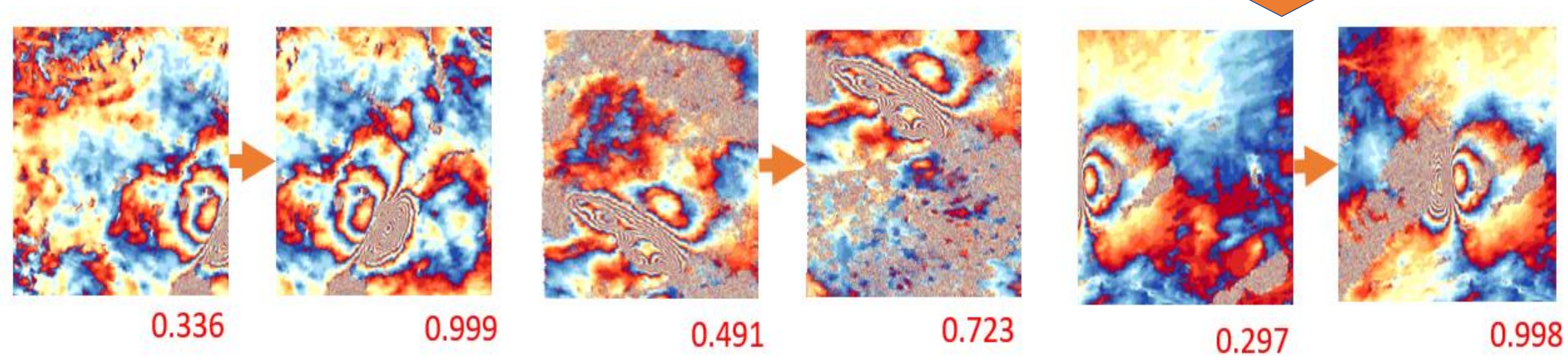


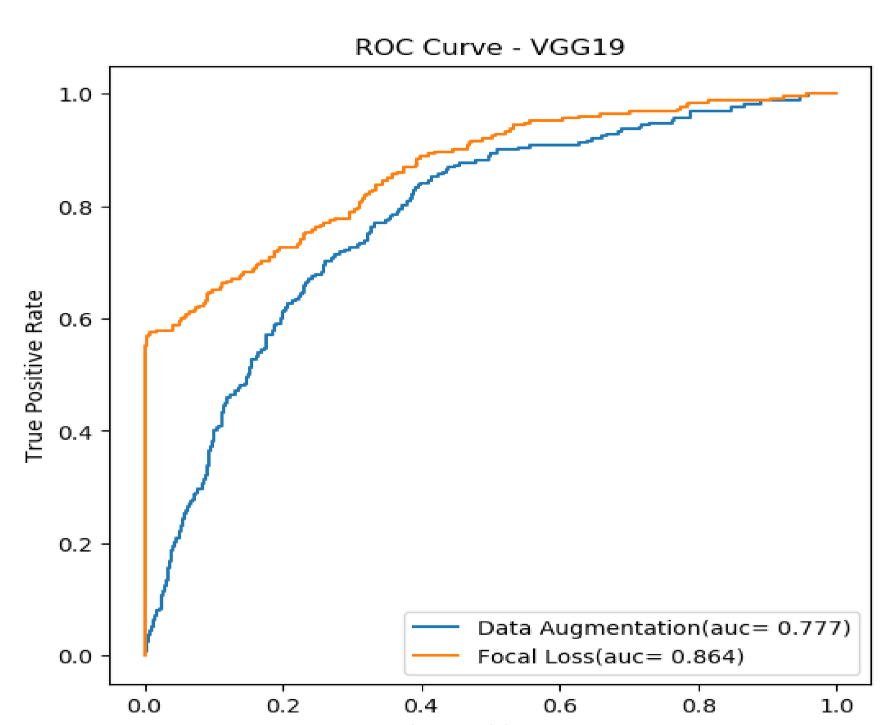


Wrapped interferograms better then Unwrapped

VGG19 Best fringes finder

Good results With overlapped patch





Focal loss performs better than data augmentation to deal with unbalanced data

Conclusion

1. We successful create two InSAR datasets.
2. Wrapped interferograms proves to be better to train deep learning models.
3. VGG19 was the best model to detect earthquake deformation fringes
4. Focal Loss proves to be better to deal with data unbalanced then data augmentation.

5. We consider that a bigger dataset with more earthquake cases can improve these results.
6. Knowing the reasons why some patches have bad classification comparing with the overlapped ones we can create a well chosen patches to train and improve the results.