Semi-Supervised Classification and Segmentation on High Resolution Aerial Images

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2021

Introduction

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  - Vital for quick response and large scale recovery.
- Challenges related to gathering visual data.
  - Cost of labeling the data.
  - Time for labeling the data.
- Unsupervised and Semi-supervised learning is the solution!

FloodNet Dataset

The dataset consists of 1450 train images (2343 total) taken from a UAV after hurricane Harvey. Out of this dataset 400 images are labeled while 1050 images are unlabeled.

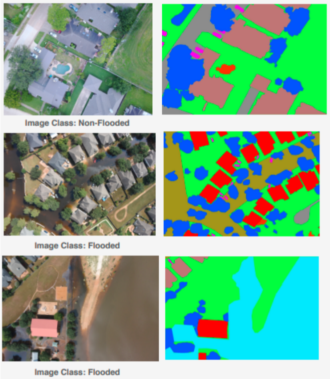

Figure: Few samples from the FloodNet dataset

Semi-Supervised Methodology

Input: Sample image
Output: Class of the given image
for $epoch \leftarrow 0$ **to** E **do**
    if $epoch < E_i^\alpha$ **then**
        $\alpha \leftarrow \alpha_i$
    else if $epoch < E_f^\alpha$ **then**
        $\alpha \leftarrow \frac{\alpha_f - \alpha_i}{E_f^\alpha - E_i^\alpha} * (epoch - E_i^\alpha) + \alpha_i$
    else
        $\alpha \leftarrow \alpha_f$
    end if
    Run the model on train set
    $loss \leftarrow BCE(I, \hat{I}) + \alpha * BCE(u_{epoch}, u_{epoch-1})$
    Generate the pseudo labels for unlabeled data
    Evaluate the model on validation set
end for

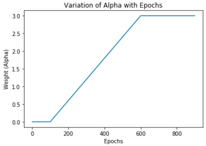

Figure: Change of alpha over epochs

Models Used

- Classification
  - ResNet18 with a binary classification head
- Segmentation
  - DeepLabV3+
  - ResNet34 backbone

Classification Results

Model	Training Accuracy	Test Accuracy	#params
InceptionNetv3	99.03%	84.38%	23.8M
ResNet50	97.37%	93.69%	25.6M
Xception	**99.84**%	90.62%	22.9M
ResNet18 (our)	96.69%	**96.70%**	**11.6M**

Table: Classification models comparison

Segmentation Results

Method	Back-ground	Building NF	Building Flooded	Road NF	Road Flooded	Water	Tree	Vehicle	Pool	Grass	**mIoU**
UNet	0.	0.	0.34	0.	0.45	0.49	0.47	0.	0.	0.64	0.239
PSPNet	0.04	0.45	0.66	0.32	0.73	0.61	0.71	0.14	0.18	0.82	0.4665
DLV3+	0.16	**0.49**	**0.69**	0.45	**0.76**	**0.72**	**0.76**	0.14	**0.18**	**0.85**	0.5204
DLV3+ (SSL)	**0.17**	0.48	**0.69**	**0.48**	0.75	**0.72**	**0.76**	**0.15**	**0.18**	**0.85**	**0.5223**

Figure: Segmentation models comparison

Segmentation Samples

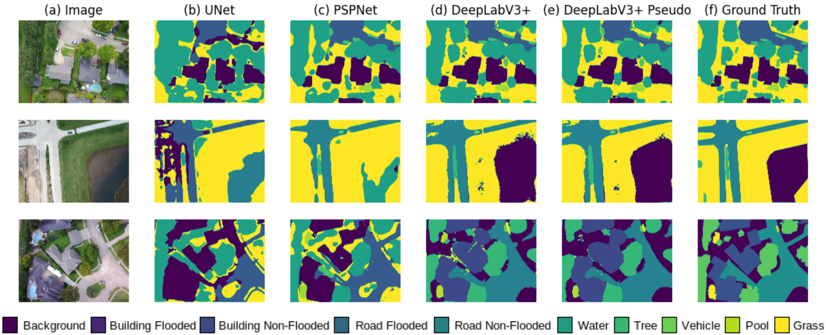

Figure: Visual comparison on FloodNet dataset for semantic segmentation

Conclusions and Future Work

- Explored semi-supervised classification and segmentation methods
- Handled class imbalance
- Increase of 0.19% mIoU on using pseudo labels, provides wide scope for improvement on increasing unlabeled data.

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- Explored semi-supervised classification and segmentation methods
- Handled class imbalance
- Increase of 0.19% mIoU on using pseudo labels, provides wide scope for improvement on increasing unlabeled data.
- Self-supervised pretraining, attention based models, addition of discriminative loss and vision transformers

Contact Us!

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- GitHub Repository
  https://github.com/sahilkhose/FloodNet