DATA AUGMENTATION IN PROTOTYPICAL NETWORKS FOR FOREST TREE SPECIES CLASSIFICATION USING AIRBORNE HYPERSPECTRAL IMAGES

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Data Augmentation is All You Need

Data augmentation in computer vision domain:

Work	Year	Data Augmentation Method
LeNet-5	1998	Image affine transformation.
AlexNet	2012	Sample rescaling, random cropping, horizontal flipping, and color jittering.
VGG	2014	Multiscaling and cropping.
GoogLeNet	2014	Multiscaling and cropping.
ResNet	2015	Geometric transformation.
DenseNet	2017	Geometric transformation.

Training data-driven deep learning model:
- Improving sample diversity.
- Minimizing the overfitting problem.

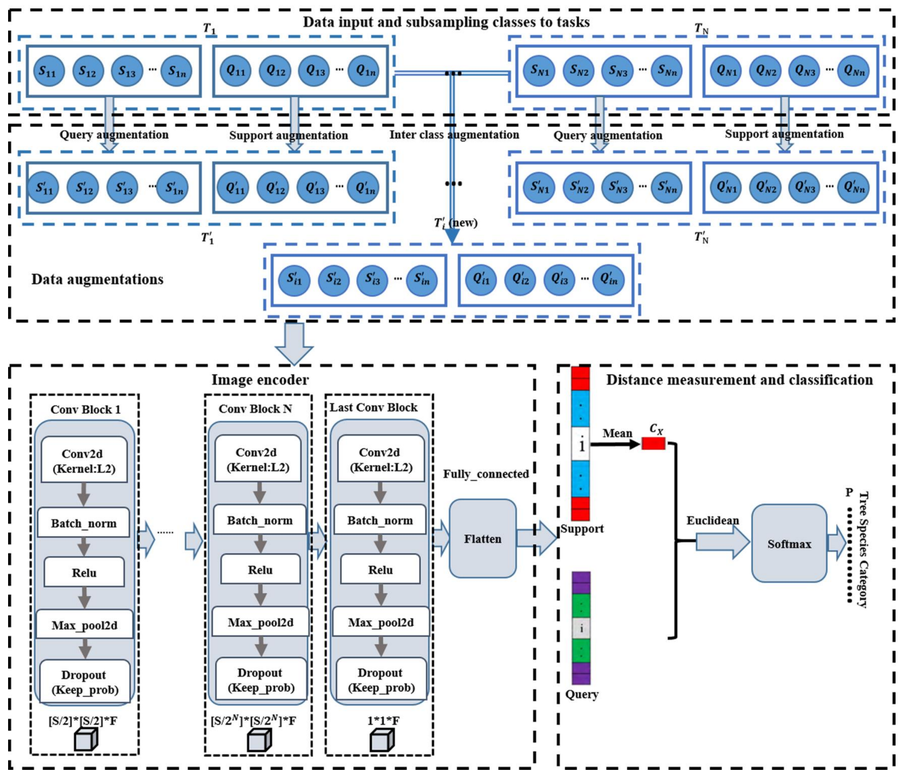
Other Popular Data augmentations and their characteristics:

Work	Year	Characteristics
SMOTE	2002	Multi sample augmentation; Solving the problem of samples unbalanced between categories.
SamplePairing	2018	Multi sample augmentation; Linear interpolation between samples (average value per pixel).
CutOut	2017	Single sample augmentation; Solving the problem of data occlusion.
Random Erasing	2020	Single sample augmentation; Solving the problem of data occlusion.
GridMask	2020	Single sample augmentation; Solving the problem of data occlusion.
MixUp	2017	Multi sample augmentation; Linear interpolation between samples according to a ratio; Soft label.
CutMix	2019	Multi sample augmentation; Patch cropping and filling using other sample; Soft label.

Our contributions:
- According to the data inputs of the prototypical networks (P-Net), we define three data augmentation modes (support augmentation, query augmentation, and inter-class augmentation) and discuss the optimal data augmentation methods of each mode.
- Based on these experiments, we combine data augmentations that can obtain better performance than the baseline (no augmentation [NA]) to expand the data augmentation pool.
- We introduce a MaxUp strategy in P-Net, named Proto-MaxUp (PM), and achieve further performance boosts for tree species classification using the airborne hyperspectral images.
- For P-Net with different backbones, we compare the classification performance of NA and using PM strategy to augment the training data, to define an optimal architecture for tree species classification.

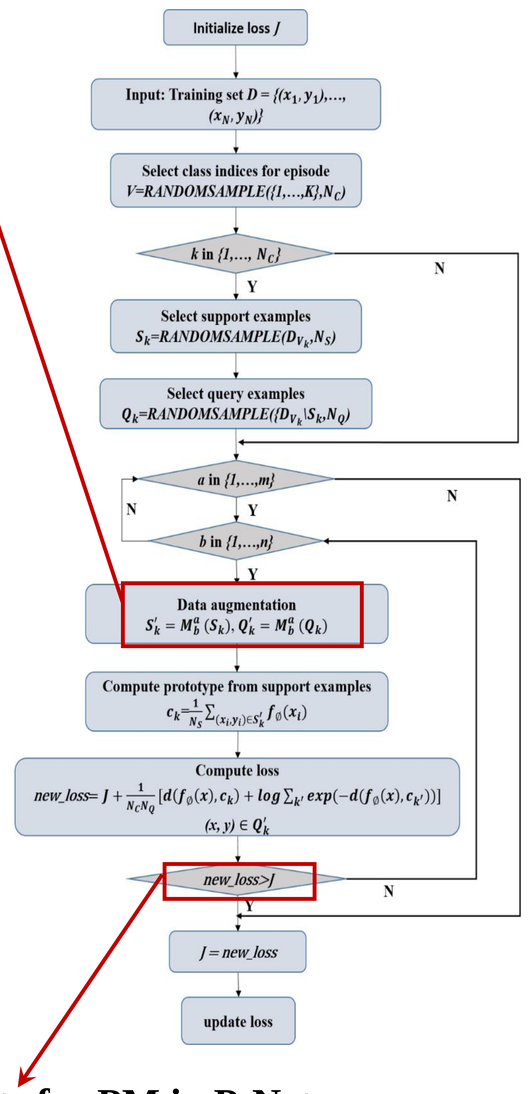
The Overall Architecture of PM in P-Net

PM is proposed to minimize the issue of overfitting
- It includes data input and subsampling classes to tasks, data augmentations, image encoder, distance measurement, and classification.
- Our work focuses on the data augmentations part.



Algorithm Flow and Experiments Scheme

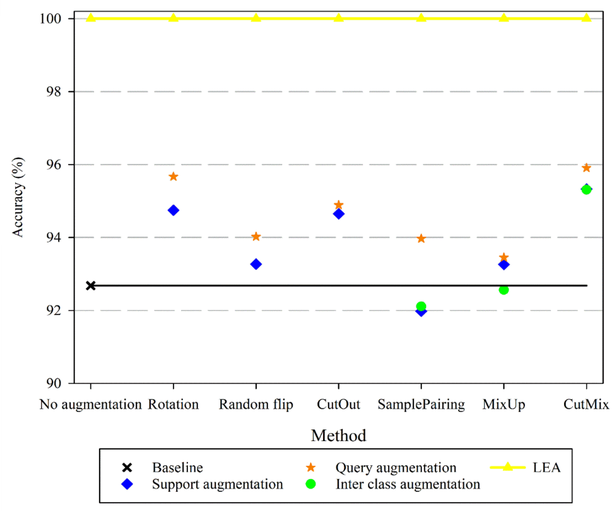
Experiments for data augmentation in P-Net
- Comparison of data augmentation modes.
- Combination of different data augmentation methods.



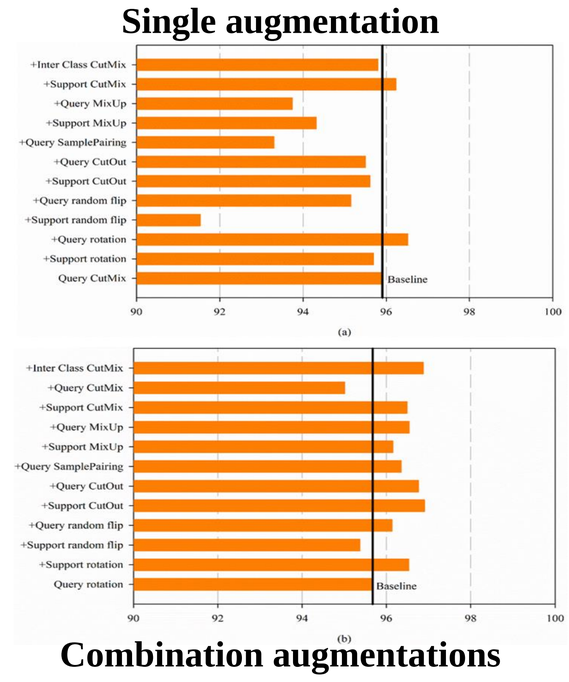
Experiments for PM in P-Nets
- Using Proto-MaxUp to further improves classification performance.
- Proving the effectiveness of Proto-MaxUp strategy through other datasets.

Classification Results

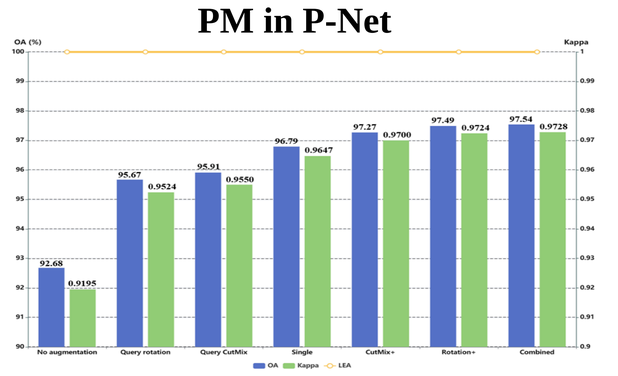
Data augmentation methods in P-Net

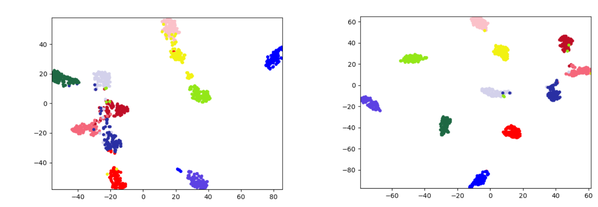


Single augmentation



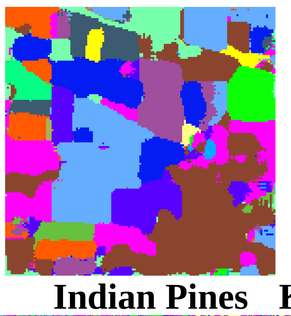
Combination augmentations PM in P-Net



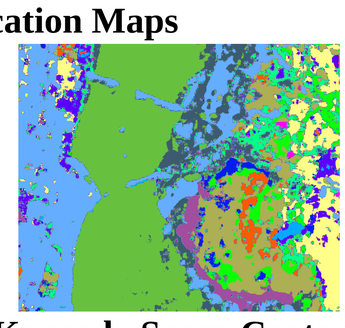


No augmentation **Combined**

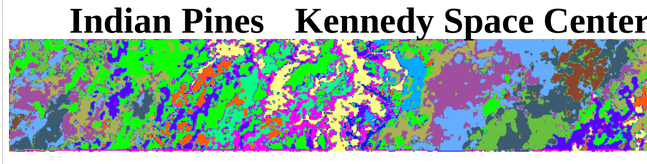
Classification Maps



Indian Pines

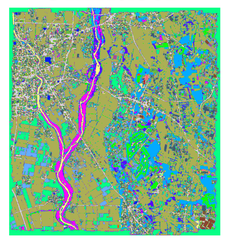


Kennedy Space Center



Botswana

Chikusei



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