Attentional Road Safety Networks

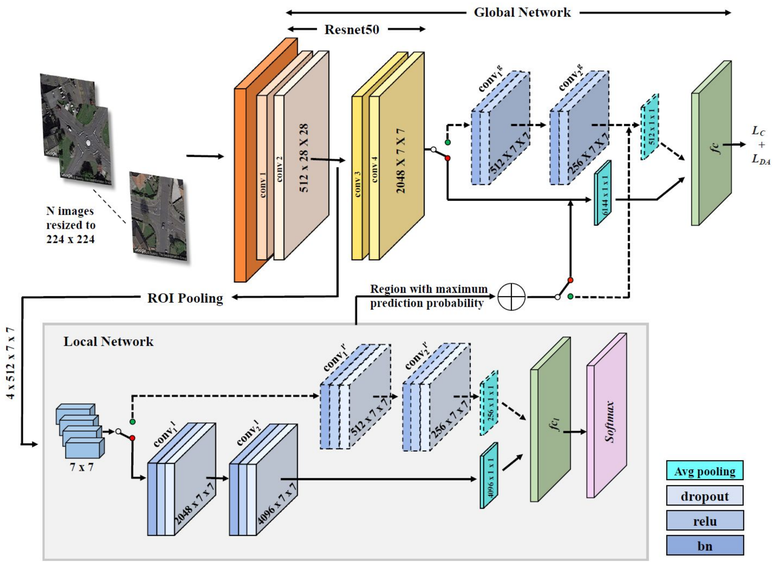
Sonu Gupta, Deepak Srivatsav, AV Subramanyam, Ponnurangam Kumaraguru

IIIT Delhi

Introduction

- Road Safety Mapping using Satellite imagery is a challenging problem, due to the scarcity of labeled data.
- We obtained satellite data for London, New York and Denver
- We trained a model on the data obtained for London, and then performed domain adaptation for the unlabeled data of New York and Denver

Model Architecture



- Deep Attention Model (DAM) - DAM a Global and a Local Network. The Local Network learns features pertaining to image sections that are more relevant to the class prediction

Domain Adaptation

- Domain Adaptation Loss utilizes the Between and Within class covariance of samples in the source and target domain

$$\Sigma_{SW} = \Sigma_{i,j \neq i}(x_i - x_j)(x_i - x_j)^T + \Sigma_{i,j \neq i}(y_i - y_j)(y_i - y_j)^T$$

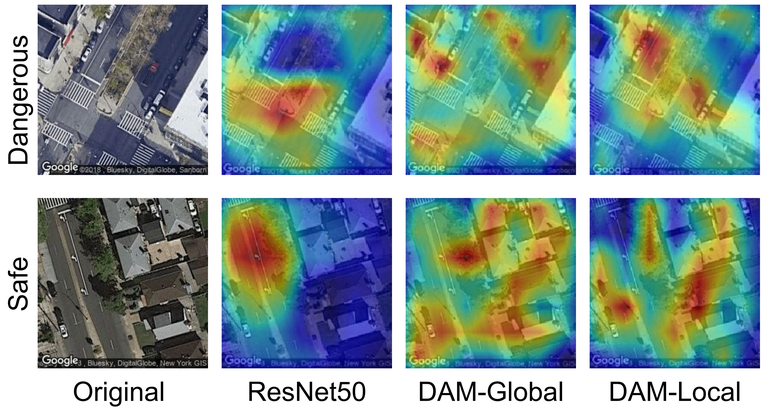
$$\Sigma_{SB} = \Sigma_{i,j}(x_i - y_j)(x_i - y_j)^T$$

$$L_{DA} = \|\Sigma_{SW} - \Sigma_{TW}\|^2 + \|\Sigma_{SB} - \Sigma_{TB}\|^2$$

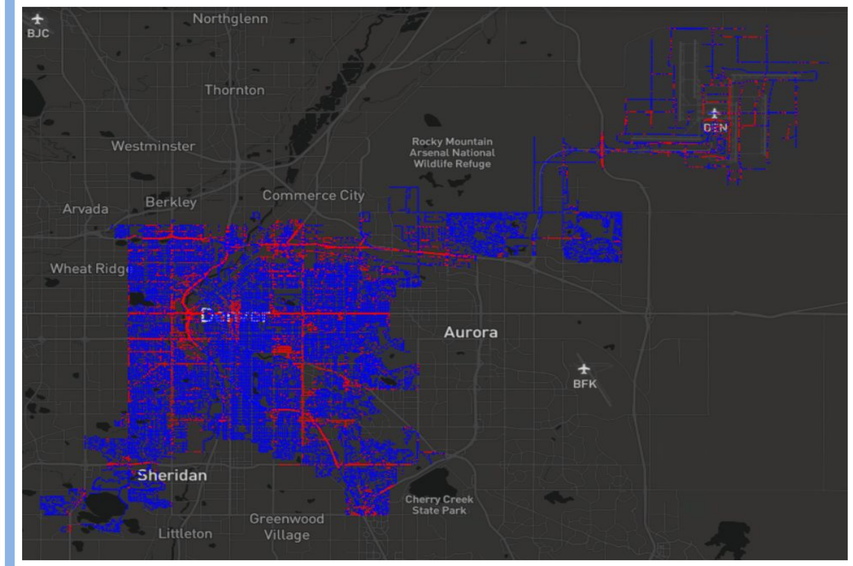
- We also compared the performance against a model using a loss function where the class labels are not taken into account.

$$L_{DA}^{ST} = \|C_S - C_T\|^2$$

Activations



- Class Activation Maps - Represents features learned by the local and global network vs features learned by ResNet50



Results

Model	London	New York	Denver
ResNet50	85.77	69.16	70.00
VGG19	85.83	64.60	70.00
DAM(HS)	85.81	72.28	**76.20**
DAM(VS)	85.82	**74.77**	75.00
DAM(SQ)	85.86	70.70	70.00
DAM(HS+VS)	85.34	70.37	70.01
DAM(HS+VS+SQ)	**86.21**	67.23	69.86

Model	Accuracy(%)	FPR(%)
DAM	71.94	30.03
DAM-DA-L_{DA}	75.75	19.94
DAM-DA-L_{DA}^{ST}	74.73	30.69