**Deep Learning-Based Change Detection of Urban Forest, Water, Barren Land, and Human Activity**

**Keywords:** deep learning; transfer learning; forest cover change detection; river change detection; barren land detection; very high resolution (VHR); DeepLabv3+; deeply supervised image fusion network (DSIFN); desertification

**Expected output**

* Grayscale segmented 2D map of an urban region, based VHR satellite image, classes include forest, water, barren land, and human activity (buildings, roads, agriculture).
* Colour coded map that shows region of change, based on pre- and post-VHR satellite image of region.

**Potential use**

* Forest conservation: Monitoring. Intervention impact analysis.
* Urban planning: City growth.
* Desertification identification: Monitoring. Intervention impact analysis.

**Datasets**

* LoveDA [GitHub - Junjue-Wang/LoveDA: [NeurIPS 2021] LoveDA: A Remote Sensing Land-Cover Dataset for Domain Adaptive Semantic Segmentation](https://github.com/Junjue-Wang/LoveDA)
* Change Detection Dataset

**Unexplored Datasets**

* [Desertification Monitoring Using Machine Learning Techniques with Multiple Indicators Derived from Sentinel-2 in Turkmenistan](https://www.mdpi.com/2072-4292/16/23/4525)

**Data Preparation**

1. LoveDA

Category labels: background – 1, building – 2, road – 3, water – 4, barren – 5, forest – 6, agriculture – 7. And the no-data regions were assigned 0 which should be ignored. The provided data loader will help you construct your pipeline.

Original image and mask:

A black background with a square object

Description automatically generated An aerial view of a construction site

Description automatically generated

Merged labels:

* Forest: 6 -> 1 (Bright Green)
* Water: 4 -> 2 (Bright Blue)
* Barren land: 5 -> 3 (Bright Orange)
* Human activity: 2, 3, 7 -> 4 (Bright Magenta)
* Background: 1 -> 5 (Gray)
* No-data: 0 -> 0 (Black)

Image ‘1366’ from train dataset:

A map of a city

Description automatically generated A colorful squares and rectangles

Description automatically generated

Image ‘3520’ from validation dataset:

A map of a city

Description automatically generatedA map of different colors

Description automatically generated

1. Change Detection Dataset

Image ‘19’ from Real/subset/train. From left to right, B-A-OUT.

A car parked next to a road

Description automatically generated Aerial view of a neighborhood

Description automatically generated A black and white map

Description automatically generated

**Transfer learning**

1. DeepLabv3+

80/20 train/test split, 20 epochs, training time …, Train loss graph, Test loss graph, Training time

M. S. Minhas, “Transfer Learning for Semantic Segmentation using PyTorch DeepLab v3,” GitHub.com/msminhas93, 12-Sep-2019. [Online]. Available: <https://github.com/msminhas93/DeepLabv3FineTuning>.

1. VGG16

No additional fitting is done, as the model up to pool5 is used for feature extraction (Simonyan and Zisserman, 2014).

**Deeply Supervised Image Fusion Network (DSIFN)**

50 Epochs

[A deeply supervised image fusion network for change detection in high resolution bi-temporal remote sensing images - ScienceDirect](https://www.sciencedirect.com/science/article/pii/S0924271620301532)

[Step by step VGG16 implementation in Keras for beginners | by Rohit Thakur | Towards Data Science](https://towardsdatascience.com/step-by-step-vgg16-implementation-in-keras-for-beginners-a833c686ae6c)

**Generated Change Maps**

A collage of images of a road

Description automatically generated

On validation set (2998 samples), F1 score of 0.65466

**Generated Urban Activity Segmentation**