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July 9th, 2021

A Deep Learning Approach to Flood Detection in Satellite Imagery

Abstract

This study uses a siamese neural network to detect flooding in landsat satellite imagery. Flooding was classified by the dissimilarity value obtained through the process of the siamese neural network, a pairwise distance function and sigmoid activation function. 269/270 images in the training dataset were categorized correctly and 51/52 test images were categorized correctly.

Design

This study presents an approach to automatically detect flood regions using landsat satellite data. Detecting floods in a fast and precise way is crucial as it helps in improving crisis management and consequently reducing damages of the natural disaster phenomenon. Deep neural networks are demonstrating improvement in their ability to handle big data to implement a variety of tasks such as object detection, change detection, and object classification. In August 2016, prolonged rainfall from an unpredictable storm resulted in catastrophic flooding in the state of Louisiana, United States; thousands of houses and businesses were submerged.

Data and Design

The data for this project consisted of 322 landsat optical satellite imagery of the 2016 Louisiana flood. The dataset consisted of image pairs both taken at the same location with the same footprint. The pair of images are before and after (or during) the flooding event. A certain number of after images contained flooding and others did not. A siamese neural network was established to input the pair of images through, using MobileNetv2, a parallel identical neural network that evaluates the features in the before image and after image. The pairwise distance is measured between the images. That distance is put through a sigmoid activation function which results in a dissimilarity value/threshold. For my final model, the threshold dissimilarity value for whether flooding has occurred was calculated to be 0.4024.

Tools

Tools used for this project included:

- 1) Pytorch and Torchvision for the siamese neural network
- 2) Numpy for linear algebra (pairwise distance)
- 3) Pandas for data processing and loading the y_target CSV
- 4) SKlearn for statistical analysis
- 5) Matplotlib for data visualization