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Week 8 Problem 3

DSC550-302

In my research for an article of a neural network that solved a problem, I located a thesis that discussed devising a way to provide an alternate system to the Global Navigation Satellite Systems for unmanned aircraft. This alternate system is a backup for when its Global Positioning System (GPS) becomes jammed or spoofed. When jamming occurs, it can deny or provide inaccurate location data. In the case of when a GPS system does become compromised, the aircraft’s location is thwarted, and flight safety has become the main concern. With a combination of public satellite imagery, government high resolution satellite imagery and machine learning; navigation within the aircraft becomes the alternative needed for this geospatial location solution.

Within the article, the neural networks used were Artificial Neural Network and Convolutional Neural Network. Artificial Neural Networks are setup to mimic the human nervous system and brain. It is made up of interwoven process elements that are referred to as neurons. These neurons work together to solve problems. If the neural network is made up of one layer it is called a perceptron, which is a single output. Convolution Neural Network is an algorithm that can use an image as an input, assign weights or synapses and biases to objects within the image. It does this process to know the difference between images. Convolutional Neural Networks have the ability to capture spatial and temporal dependencies within an image, with the use of certain filters. Hence, the algorithm can be trained to comprehend each image better.

The original dataset for this solution was around 675 satellite images for training and 112 images for testing. The images were reduced in size to be placed within the Convolutional Neural Network. The mean size of an image was 139 million pixels. To further train the network, another training and test set of 100,000 images were inputted. Python was used for creating these datasets, as were multiple packages and Keras functional API was utilized to create the network. A hyper-parameter comparison was conducted to understand which parameter performed the best. It was between weight initializations, optimizer functions and finishing layers. The parameters were trained between 50 to 150 epochs. Each of the models took more than 20 hours to train. According to Berhold, the best results were in the networks that contained the root mean squared prop optimizer, a flatten finishing layer and orthogonal weight initializer. Convolution Neural Networks were used for this experiment due to the fact that they are best used for image classification.

Since this experiment contained only images from the Dayton area, I would be curious to know if terrain would make a difference in results. It was mentioned that sun position was a factor to consider. What if the area is flooded or there has been a fire, like in Australia? Would the dataset have to be retrained and retested due to geospatial differences from one satellite image to another?

Reference:

[1] Berhold, Jedediah M., "*Convolutional Neural Network Architecture Study for Aerial Visual Localization*" (2019). Theses and Dissertations. 2246.

<https://scholar.afit.edu/etd/2246>

[2] Chauhan, N., (2019), *Introduction to Artificial Neural Networks (ANN)*, Your first step in Deep Learning, Towards Data Science, Retrieved from: <https://towardsdatascience.com/introduction-to-artificial-neural-networks-ann-1aea15775ef9>

[3] Saha, S., (2018), *A Comprehensive Guide to Convolutional Neural Networks – the ELI5 way*, Toward Data Science, Retrieved from: <https://towardsdatascience.com/a-comprehensive-guide-to-convolutional-neural-networks-the-eli5-way-3bd2b1164a53>