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Feature Extraction of High Resolution Satellite Image

Antara Gaikwad[1], Ruth Paul[2], Vishakha Soman[3], Shatayu Mondhe[4], Shubham Kalaskar[5], Manoj V. Bramhe[6]

[1,2,3,4,5]*Student, Department of Information Technology, SVPCET, Nagpur, India*

[6]*Associate Professor, Department of Information Technology, SVPCET, Nagpur, India*

***Abstract*: Extraction of features from high resolution satellite is an area still under research. This paper proposes a system for classification of high resolution image. Following on, the use of convolution neural network and the way it functions in extracting information is investigated in this paper. The main purpose is to utilize Deep learning using convolution neural network. The system that has been proposes functions in two phases. The first phase is learning, where the neural network is trained with test data. The second phase is called application where the knowledge obtained in the first phase is used for detecting and extracting features. The extraction results are compared with the manually obtained ones.**

***Keywords*: convolution neural network**

1. Introduction

Image processing is the analysis and manipulation of digital image with the use of computer in order to improve its quality. Feature extraction plays a major role in image processing. It is a special form of dimensionality reduction. The main goal of feature extraction is to obtain the most relevant information in lower dimensionality space [1]. Image classification is a task of extracting information from a multiband raster image which plays an important role in image processing. The objective of image classification is the automatic allocation of image to thematic classes [2]. The process of image classification involves two steps, training of the system followed by testing. The training process means to take the characteristic properties of the images (form a class) and form a unique description for a particular class. The testing step means to categorize the test images under various classes for which system was trained. This assigning of class is done based on the partitioning between classes based on the training features [3]. Deep learning refers to the number of layers through which data is transformed. It is a class that learn multiple levels of representations that correspond to different levels of abstraction; the levels form a hierarchy of concepts. This work aims at the application of Convolutional Neural Network or CNN for image classification.

2. Types of classification

Two types of classification are there supervised classification and unsupervised classification.

Supervised classification is based on the idea that a user can select sample pixels in an image that are representative of specific classes and then direct the image processing software to use these training sites as references for the classification of all other pixels in the image. Training sites are selected based on the knowledge of the user. Unsupervised classification is where the outcomes (groupings of pixels with common characteristics) are based on the software analysis of an image without the user providing sample classes [5].

3. Convolution neural networks

Computational models of neural networks have been around for a long time, first model proposed was by McCulloch and Pitts as in [6]. The neural network is composed of a large number of highly interconnected processing elements working in parallel to solve a specific problem. In feed forward neural network the neurons are connected in a directed way having the input layer and output layer. The layers between these layers are called as hidden layers. The data is fed into the model and output from each layer is obtained and this step is called as feed-forward, then error function is used to calculate the errors. After that, we back propagate into the model by calculating the derivatives [8]. This step is called back propagation which basically is used to minimize the loss. Learning occurs through adjustment of weights and the process of weight adjustment is repeated in a recursive manner until weight layer connected to input layer is updated [3].

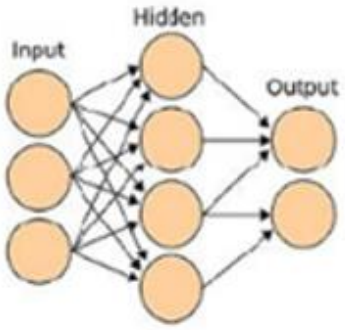

Fig. 1. Typical network architecture

4. Working of CNN

This section explains the working of the algorithm. The input is provided with the 2D image. The input layer takes the 2D image as input and the output layers is the layers from where we get the trained output. The hidden layers are the intermediate layers. Each hidden layer is made up of a set of neurons and each neuron is fully connected to all the previous layers neuron. Convolution neural network algorithm works as a series of convolutional and sub-sampling layers.

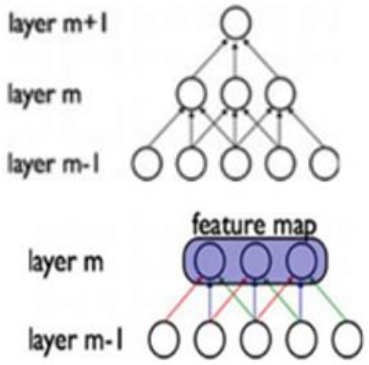

Fig. 2. Graphical flow of layers showing connection between layers and sharing of weights

Figure 2 shows the basic architecture of neural network. In the figure the neurons in layer 'm' are connected to a local subset of neurons of layer (m-1), which is the previous layer. The neurons in layer (m-1) have contiguous receptive fields. In the convolution neural network algorithm, the sparse filter is reproducing over the entire visual field. The units thus formed establish a feature maps that share weight vector and bias. Figure 2 represents three hidden units of same feature map. Such a replication of sparse field

A. Convolutional layer

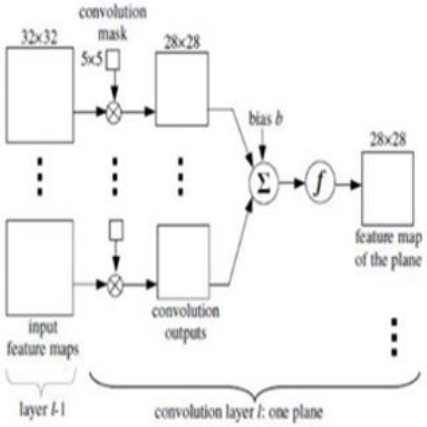

Fig. 3. Convolutional layer working

The convolution layer is the first layer of the convolution neural network algorithm. The structure of this layer is shown in the Fig. 3. [3]. It consists of a convolution mask, bias terms and a function expression. All these units together, generate output of the layer. The figure below shows a 5x5 mask that performs convolution over a 32x32 input feature map. The resultant output in a 28x28 matrix. After obtaining the matrix the bias is added to it and then the sigmoid function is applied.

B. Sub- sampling

A pooling or subsampling layer often immediately follows a convolution layer in CNN. Its role is to down sample the output of a convolution layer along both the spatial dimensions of height and width. For example, a 2 x 2 pooling operation on top of 12 feature maps will produce an output tensor of size [16 x 16 x 12]. The primary function of a pooling later is to reduce the number of parameters to be learned by the network. This also has the additional effect of reducing overfitting and thereby increasing the overall performance and accuracy of the network.

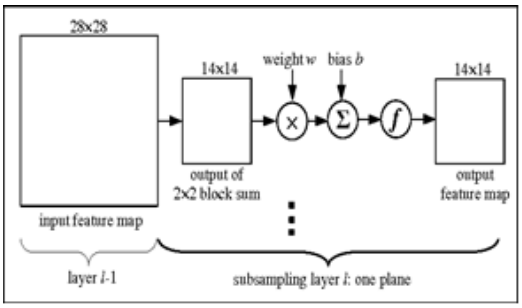

Fig. 4. Sub sampling layer working [7]

5. Conclusion

This paper presented the feature extraction of the high resolution satellite image.

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