DATA AUGMENTATION APPROACHES FOR SATELLITE IMAGE RESOLUTION

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Abstract

Data augmentation is a well known technique that is frequently used in machine learning tasks to increase the number of training instances and hence decrease model over-fitting. In this paper we propose a data augmentation technique that can further boost the performance of satellite image super resolution tasks. A super-resolution convolutional neural network (SRCNN) was adopted as a state-of-the-art deep learning model to test the proposed data augmentation technique. Different augmentation techniques were studied to investigate their relative importance and accuracy gains. We categorized the augmentation methods into instance based and channel based augmentation methods. The former refers to the standard approach of creating new data instances through applying image transformations to the original images such as adding artificial noise, rotations and translations to training samples, while in the latter we fuse auxiliary channels with each training instance, which helps the model learn useful representations.

Keywords: *data augmentation; optical remote sensing image; ship detection; simulated samples; deep learning*

Introduction

Technology aimed at the detection of ships has prospects for wide application in the military and civilian fields. With the development of remote sensing technology, inshore ship detection has become a hot topic for the application of remote sensing images. The biggest challenge for inshore ship detection is the changing background. In addition, ships, which form the main mode of transportation at sea, can be of varying types and shapes. This makes their accurate detection difficult.

In recent years, with the advancement of deep learning techniques (especially the convolutional neural network (CNN)), research and development on object detection techniques has significantly progressed. A number of methods that use convolutional neural networks to detect ships have been proposed in recent years. Ship detection requires not only image data, but also extensive manual annotation, which is costly, labor-intensive, and time-consuming. However, there is a lack of images of ships that make special appearances or are in unique situations.The Generative Adversarial Network (GAN) has also been used to make progress in data augmentation. GAN-based methods have produced high-quality images in some datasets. However, the GAN-based methods are difficult to train and require a certain amount of data.These methods could make good use of the information in the images; however, they do not essentially increase the quality of the dataset. To address this problem, this paper proposes a method that combines a three-dimensional model of a ship with remote sensing images to construct simulation images that help to augment the training data. Better results can be obtained by adding new information to the images.The main contributions of this paper are as follows. To address the problem of an insufficient number of training samples, a training strategy to produce simulation images is proposed that augments the dataset. Meanwhile, new information on ship models is added to the images. This results in networks that are trained more effectively. In addition, the bounding boxes of the simulated ship objects are automatically annotated. The application of this method to inshore images saves time and effort as compared to manual annotation.

Classification of land uses is an essential input in applications that range including urban planning and zoning, and the issuance of business permits, real estate construction and assessment as well as infrastructure development. Land use classification in urban areas is generally made using surveys by professionals who are trained. This job is extremely labor-intensive, irregular expensive, slow and inefficient. This is why such data are generally available in advanced countries and in large cities that have the capacity and expertise to gather and analyze the data. However, this information isn't available in many of the regions with lower incomes as well as many emerging nations where it is most required. The need for paper is based upon two trends which promise to improve the analysis of urban environments more inclusive and democratic process.A system with the capability of forecasting the future preferences of a user on a particular set of items is known as a Recommendation System. People around all over world have a lot of choices available and that's why they require use of recommendations. In past, people would shop at stores where only a few products were readily available. The amount of information available on internet is vast, which causes consumers to be unable to purchase appropriate item in accordance with the needs. This is where RS comes in.

Literature review

Oluwadara Adedeji et al (2022) This study proposes the use of generative models (GANs) for augmenting the EuroSAT dataset for the Land Use and Land Cover (LULC) Classification task. We used DCGAN and WGAN-GP to generate images for each class in the dataset. We then explored the effect of augmenting the original dataset by about 10% in each case on model performance. The choice of GAN architecture seems to have no apparent effect on the model performance. However, a combination of geometric augmentation and GAN-generated images improved baseline results. Our study shows that GANs augmentation can improve the generalizability of deep classification models on satellite images.

Spoorthi D. M (2021) Satellite imagery is important for many applications including disaster response, law enforcement, and environmental monitoring. These applications require the manual identification of objects and facilities in the imagery. Because the geographic expenses to be covered are great and the analysts available to conduct the searches are few, automation is required. Yet traditional object detection and classification algorithms are too inaccurate and unreliable to solve the problem. Deep learning is a family of machine learning algorithms that have shown promise for the automation of such tasks. It has achieved success in image understanding by means of convolutional neural networks (CNNs).

Data Augumentation

Data augmentation is a set of techniques to artificially increase the amount of data by generating new data points from existing d ata. This includes making small changes to data or using deep learning models to gen erate new data points. Data augmentation is a process of artificially increasing the amount of data by generating new data points from existing data. This includes adding minor alterations to data or using machine learning models to generate new data points in the latent space of original data to amplify the dataset. Augmented data: Derived from original images with some sort of minor geometric transformations (such as flipping, translation, rotation, or the addition of noise) in order to increase the diversity of the training set. Data augmentation is a method to deal with the issue of limited data. In data augmentation, we opt to use a few techniques that artificially increase the amount of data from the existing data and address this problem. As mentioned before, data augmentation has become one of the most popular methods for artificially increasing the amount of data needed to train robust AI models. It's especially important for domains where acquiring quality data can be a challenge.

Satellite Image Resolution

The main feature satellite operators highlight about their imagery is resolution; however, this is not the only feature to consider. Accuracy also plays a key role in determining image quality, and it's important to understand the difference between resolution and accuracy. High-resolution is often associated with high-accuracy (and vice versa), but this is not always the case. This distinction is important to consider when purchasing satellite imagery. Resolution refers to the smallest size an object or detail can be represented in an image. Higher resolution means that pixel sizes are smaller, providing more detail. For example, 30cm resolution satellite imagery can capture details on the ground that are greater than or equal to 30cm by 30cm. Anything on the ground that is less than that size will be blended with the surrounding area to make a 30cm by 30cm square. Based on this definition, 30cm resolution imagery would capture more photographic details than 1m resolution imagery. In broad term, satellite imagery is used for tracking and measuring human and natural activity across the Earth. The satellites can also be turned and adjusted to capture detailed images of our moon.

Satellite imagery can be used to produce images of large or small parts of the world from a small section of streets to an entire hemisphere. There are many techniques that go into the type of satellite imagery that may be requested. Visible satellite pictures can only be viewed during the day, since clouds reflect the light from the sun. On these images, clouds show up as white, the ground is normally grey, and water is dark. In winter, snow-covered ground will be white, which can make distinguishing clouds more difficult. To help differentiate between clouds and snow, looping pictures can be helpful; clouds will move while the snow won't. Snow-covered ground can also be identified by looking for terrain features, such as rivers or lakes. Rivers will remain dark in the imagery as long as they are not frozen. If the rivers are not visible, they are probably covered with clouds. Visible imagery is also very useful for seeing thunderstorm clouds building. Satellite will see the developing thunderstorms in their earliest stages, before they are detected on radar.

Augmentation using Geometric Techniques

Data augmentation increases the amount of data available to train a model. The primary advantage of doing this is that it makes the model more robust and less susceptible to over fitting. In addition, it can improve the model performance by mimicking the image with different features. Different augmentation techniques have been shown to improve the model performance differently, depending on the quantity and quality of these features.

Small satellite image datasets have been used for training deep learning models in existing works. For instance, a single image for classification and semantic segmentation tasks respectively. However, data augmentation has become more popular in recent times. Several relevant augmentation techniques have been compared. Horizontal and vertical flipping had the highest accuracy out of the techniques considered for classifying satellite images. Image zooming or scale augmentation. Here, the image is zoomed in or out, depending on a rate magnitude. Rotation augmentation is another relevant technique in which several copies of an image are produced by rotating it through different angles. Furthermore, the authors in flip, translation and rotation in remote sensing scene classification. However, concluded that geometric transformations like rotation, zooming and translation have limited use for medium and low-resolution satellite data as they do not provide enough variability.

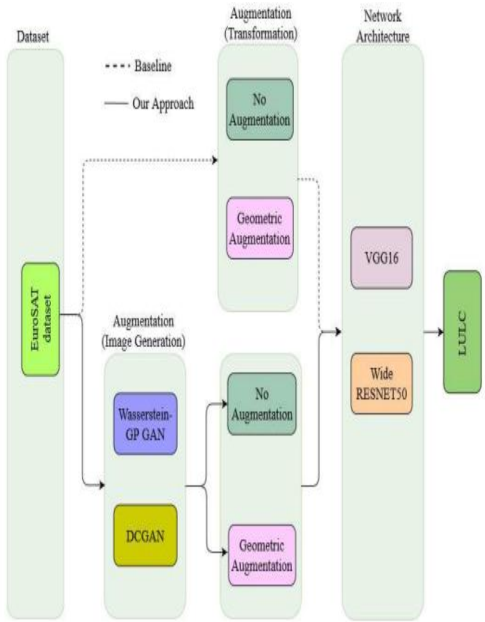

Figure: Work-layout of the project

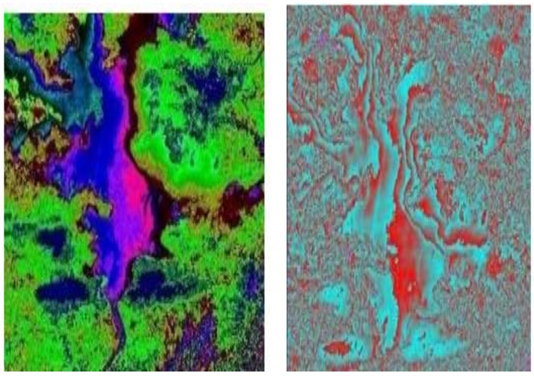

Figure: (a) Image Fusion –HIS (b) PC Component forward

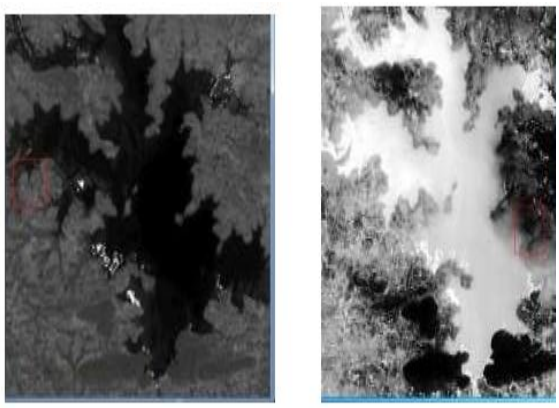

Figure: Image Fusion- Schmidt Gram Schmidt (b) Imag

Conclusion

Generative adversarial networks are a powerful tool in the machine learning toolbox. In case of satellite image processing they provide not only a good mechanism of creating artificial data samples but also enhancing or even fixing images. On the other hand GANs are really hard to train and prone to over fitting. To achieve a decent result you should be ready for a long run of trials and errors. What is important, you should pay attention not only to the visual representation offered by rgb but also check how the network behaves when working with other channels.

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