Object Detection in Low Spatial Resolution Aerial Imagery Using Convolutional Neural Networks

Aerial imagery is a valuable source of information for various applications, such as land use mapping, urban planning, and disaster response. However, the spatial resolution of aerial imagery can vary widely, from high-resolution images with a ground sampling distance (GSD) of a few centimeters to low-resolution images with a GSD of several meters.

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by Baron Arthur Ponsonby Ponsonby,

4 out of 5

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Object detection is a fundamental task in computer vision, which aims to locate and identify objects of interest in images. In the context of aerial imagery, object detection can be used to identify buildings, roads, vehicles, and other objects of interest.

Convolutional neural networks (CNNs) have been shown to be effective for object detection in high-resolution aerial imagery. However, the performance of CNNs can degrade significantly when applied to low-resolution aerial imagery due to the lack of spatial detail.

In this article, we will provide an overview of using CNNs for object detection in low spatial resolution aerial imagery. We will discuss the challenges associated with this task and present several recent approaches that have been proposed to address these challenges.

Challenges of Object Detection in Low Spatial Resolution Aerial Imagery

There are several challenges associated with object detection in low spatial resolution aerial imagery, including:

- **Small object size:** Objects of interest in low-resolution aerial imagery can be very small, making it difficult to detect and identify them.
- **Lack of spatial detail:** The low spatial resolution of the imagery can make it difficult to distinguish between different types of objects, especially when the objects are close together.
- **Noise and clutter:** Low-resolution aerial imagery often contains noise and clutter, which can make it difficult to distinguish between objects and the background.

Approaches for Object Detection in Low Spatial Resolution Aerial Imagery

Several approaches have been proposed to address the challenges of object detection in low spatial resolution aerial imagery. These approaches

can be broadly classified into two categories:

- **Super-resolution techniques:** These techniques aim to enhance the spatial resolution of low-resolution aerial imagery before applying CNNs for object detection.
- **CNN architectures designed for low-resolution imagery:** These architectures are specifically designed to handle the challenges of object detection in low spatial resolution aerial imagery.

Super-resolution Techniques

Super-resolution techniques aim to enhance the spatial resolution of low-resolution aerial imagery by combining multiple images or using deep learning-based methods.

One common approach to super-resolution is to use multiple images of the same scene taken from different angles or at different times. These images can be combined to create a single high-resolution image using image registration and fusion techniques.

Another approach to super-resolution is to use deep learning-based methods. These methods typically involve training a deep neural network to learn the mapping from low-resolution images to high-resolution images.

CNN Architectures Designed for Low-Resolution Imagery

Several CNN architectures have been specifically designed to handle the challenges of object detection in low spatial resolution aerial imagery. These architectures typically use a combination of the following techniques:

- **Large receptive fields:** Large receptive fields allow the network to capture more context and spatial information from the low-resolution images.
- **Dilated convolutions:** Dilated convolutions allow the network to increase its receptive field without increasing the number of trainable parameters.
- **Attention mechanisms:** Attention mechanisms allow the network to focus on the most important parts of the image for object detection.

Object detection in low spatial resolution aerial imagery is a challenging task, but it is an important one for various applications. CNNs have been shown to be effective for object detection in high-resolution aerial imagery, but they can struggle when applied to low-resolution aerial imagery due to the lack of spatial detail.

In this article, we have provided an overview of using CNNs for object detection in low spatial resolution aerial imagery. We have discussed the challenges associated with this task and presented several recent approaches that have been proposed to address these challenges.

As the spatial resolution of aerial imagery continues to improve, we can expect to see even more advances in object detection in low spatial resolution aerial imagery. This will open up new possibilities for using aerial imagery for various applications, such as land use mapping, urban planning, and disaster response.

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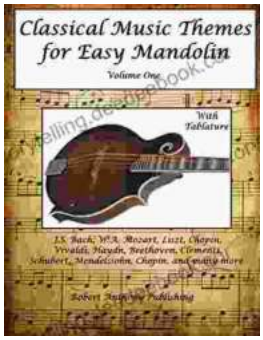

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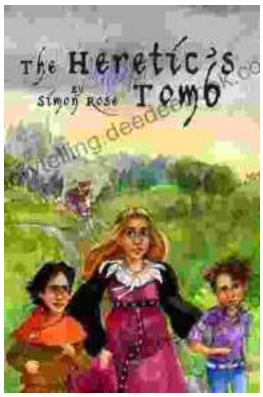

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