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Towards Rectifying the Effect on Image Registration of Pointing Inaccuracies in Nanosatellites Using Deep Convolutional Neural Networks

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Abstract

With the advent of satellite imaging with the use of nanosatellites, there is also huge potential to create a large volume of remote sensing images acquired over the same region in different periods of time by different satellites. Usually, remote sensing image datasets are geo-referenced. However, slight displacement is often seen with images from different sensors, or even within the same sensor due to pointing inaccuracies because of problems in attitude control systems. Here, we demonstrate a deep learning framework to solve such problems relating to identifying the location of satellite images by maintaining a separate repository of images from known reference satellites. Our idea is to detect the geographical location of remote sensing images using deep convolutional neural networks (CNN). We trained the VGGNet-16 model using Fully-Connected2 (FC2) features based on a reference Worldview-2 dataset to predict the geographical location based on the closest match found; in addition, it can be used to perform image registration. Performance evaluation of our proposed model is performed on different satellite images using a reference WorldView-2 satellite acquired in 2014, along with DubaiSat-2, image tiles from Google Earth, images from Sentinel-2 and Landsat-8 images acquired over an area of Abu Dhabi, United Arab Emirates (UAE).

1. Introduction

Nanosatellites are the current trend for performing diversified space science missions such as remote sensing and technological demonstrations. For remote sensing missions, it is crucial to achieve high pointing accuracies, which can be a challenge for

nanosatellites. Due to the nonlinear nature of spacecraft dynamics, coupled with many uncertainties and external/internal disturbance sources, satellites requiring high pointing accuracy need efficient attitude and determination control systems, which are often restricted by severe constraints on space, power, and mass restrictions of nanosatellites (Nudehi et al.,

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