Satellite Image Matching and Feature Extraction

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Abstract

In this report, I present a strategy for matching satellite images using a combination of deep learning and classical computer vision techniques. I first extract features from the images using a pre-trained ResNet-50 model and then compare the extracted features using cosine similarity. Additionally, using traditional OpenCV methods to align and compare similar images, keypoint matching is performed.

1 Methodology

The approach used in this project is divided into two main stages: feature extraction using a deep learning model and keypoint matching using traditional computer vision techniques.

1.1 Feature Extraction Using ResNet-50

The first step involves extracting features from the input images using a pre-trained ResNet-50 model. We leveraged the network's feature extraction capabilities by removing the final classification layer and using the output from one of the intermediate layers. This allowed us to obtain a feature vector for each image.

1.2 Comparing Features Using Cosine Similarity

Once the feature vectors were obtained, we used cosine similarity to compare the images.

1.3 Keypoint Matching Using OpenCV

After comparing the images using cosine similarity, we proceeded with keypoint matching for images that were found to be similar. We used OpenCV's keypoint detection and matching algorithms to identify and align corresponding points between the images. This step helps in providing a visual representation of the matched areas.

2 Advanced Approach

To improve the performance of the image matching process, especially for images taken in different seasons, a more advanced strategy can be used.

2.1 Using Geospatial Data to Create Masks

Geospatial data (geo data) can be utilized to create masks of specific regions in the images. By focusing on specific areas (e.g., water bodies, forests), we can extract more meaningful features. Creating these masks allows the algorithm to disregard irrelevant parts of the image and focus on the important regions.

2.2 Feature Extraction from Masked Regions

Once the masks are created, feature extraction can be performed on the masked regions. Keypoints can be extracted specifically from these regions, which are more consistent across different seasons. This approach ensures that features are robust to changes in vegetation, water levels, and other seasonal variations.

2.3 Model Training Using Keypoint Alignment

With the masked regions and extracted keypoints, a dataset can be created for training a model that aligns keypoints between two images. This model would be trained to learn the transformations needed to match keypoints between the images, thereby improving the accuracy of image matching across different conditions.

3 Conclusion

In this project, we demonstrated a strategy for matching satellite images using a combination of deep learning and traditional computer vision techniques. While the initial approach shows promising results, the advanced approach leveraging geospatial data and keypoint alignment could significantly improve the performance, especially for images captured in different seasons. Future work will focus on implementing this advanced approach and testing its effectiveness in various scenarios.