Improvements Report: Satellite Image Matching Project

Dataset Preprocessing

- **Current Approach:** The current dataset preprocessing includes resizing images and converting them to grayscale.
- **Improvement Suggestion:** Instead of simply resizing, image augmentation techniques could be applied during preprocessing. This could include techniques such as flipping, rotation, brightness adjustments, and contrast scaling, which would allow the model to become more robust to variations in the data.

Keypoint Detection and Matching Algorithms

- **Current Approach:** Three algorithms are currently implemented: SIFT, AKAZE, and ORB. SIFT is highly accurate but slow, while ORB is fast but less accurate. AKAZE offers a balance between speed and accuracy.
- **Improvement Suggestion:** Implement more modern algorithms such as **SuperGlue** or **SURF** (Speeded-Up Robust Features). SuperGlue is a deep learning-based method that improves feature matching quality by considering the relationship between all points and finding consistent matches.

Evaluation Metrics

- **Current Approach:** Basic evaluation is done using the number of good matches.
- **Improvement Suggestion:** Incorporate additional evaluation metrics such as **precision**, **recall**, and **F1-score** for keypoint matching quality. Also, use geometric verification techniques like **RANSAC** to filter outlier matches and improve robustness.

Deep Learning-Based Matching

Explore deep learning approaches for keypoint detection and matching, such as using **Convolutional Neural Networks (CNNs)** to learn features or **SuperPoint** for self-supervised learning-based keypoint detection. These approaches are more robust to changes in illumination, scale, and orientation.

Seasonal Variations

The current algorithms may struggle with large seasonal variations. Future work could incorporate **seasonal normalization techniques**, such as using domain adaptation methods that align features from images taken at different times of the year.

While the current implementation provides a good baseline for satellite image matching, significant improvements can be made to enhance the system's accuracy, speed, and robustness. By exploring more advanced algorithms, optimizing the current implementation, and introducing deep learning-based methods, the system can be made more efficient and better suited to real-world applications.