Chair for Data Processing
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# Computer Vision Challenge – Group 30

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## INTRODUCTION & OBJECTIVES

The extent of human impact on the Earth's ecosystem has reached immense proportions in the recent century. Negative consequences such as climate change, water shortages and man-made disasters have become more acute and have reached global proportions. Analysis of human influence is a rather complex problem given the proportions involved. One possible holistic approach is a satellite image-based analysis of ecosystem changes at different locations on Earth.

- Main functionality and goal of the software is a robust correspondence establishment and perspective allignment.
- Special emphasis is put on robustness to rotations, translation, and brightness change.
- Change visualization shall be user-centric and provide high choice granularity.

## METHODOLOGY

The proposed approach is divided into two modules, each targeting different goals. Module 1 aims at robust perspective alignment, while Module 2 strives for user-centric change visualization.

*Module 1*

- Feature-based correspondence done with SURF [1] (high robustness and efficiency).
- Matching done with SSD to estimate Euclidean image transforms with correspondence pairs.
- Robustness is enhanced by RANSAC or similar algorithms [2].
- In the case of no direct transforms, a graph algorithm determines chained, optimized transformation.

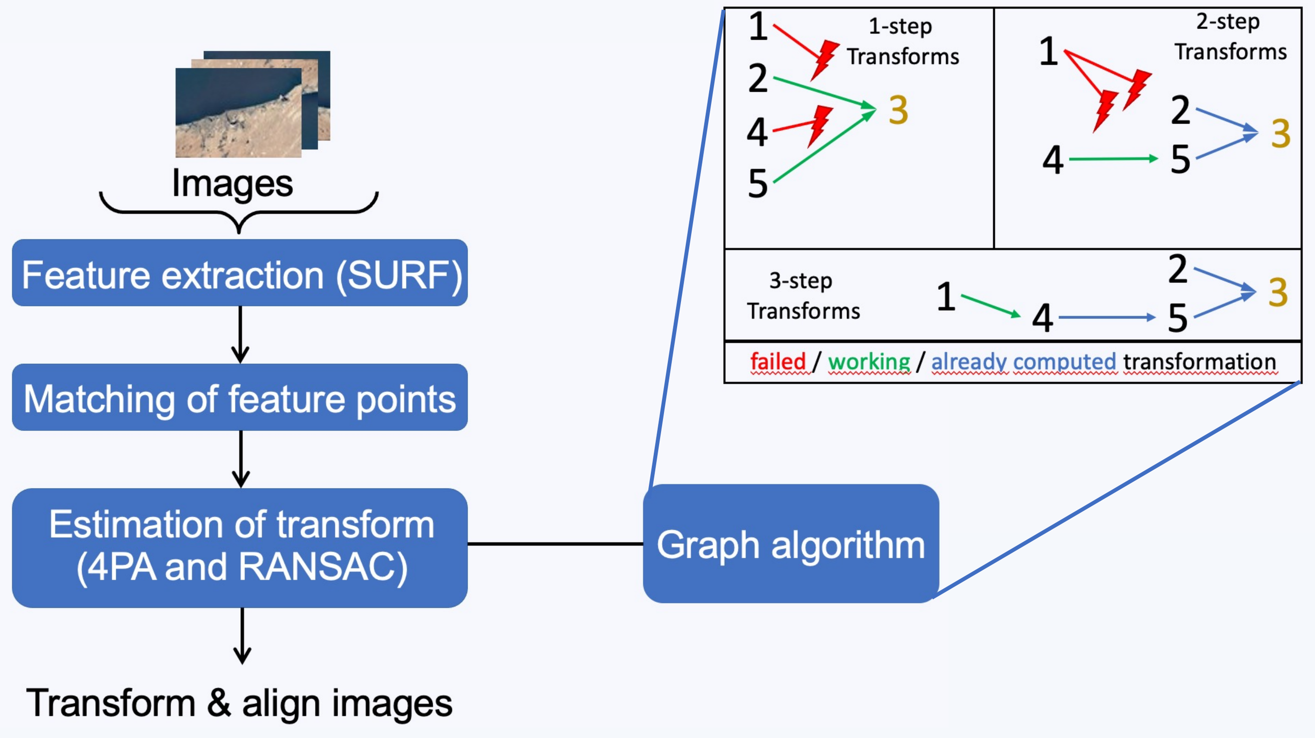



Figure 1: Graphical representation of Module 1.

*Module 2*

- Visualization of structural changes between alligned images by absolute pixel differences.
- Segmentation for image regions (e.g. rural, sea, mountains) inspired by adaptive thresholding [3].
- Visualization of pixel difference clusters or outliers.
- Time lapse image show with an adaptive speed parameter.

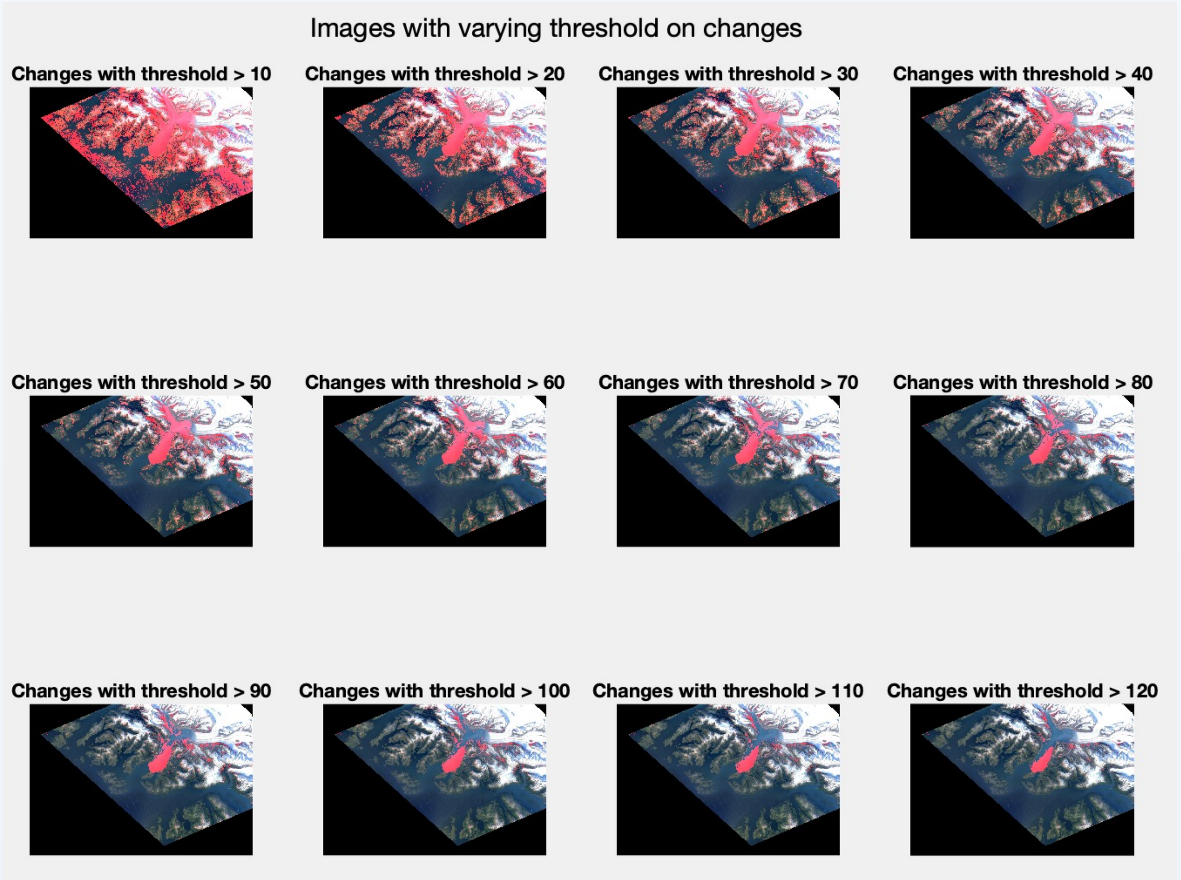



Figure 2: Absolute pixel differences with varying thresholds.

## SOFTWARE ARCHITECTURE

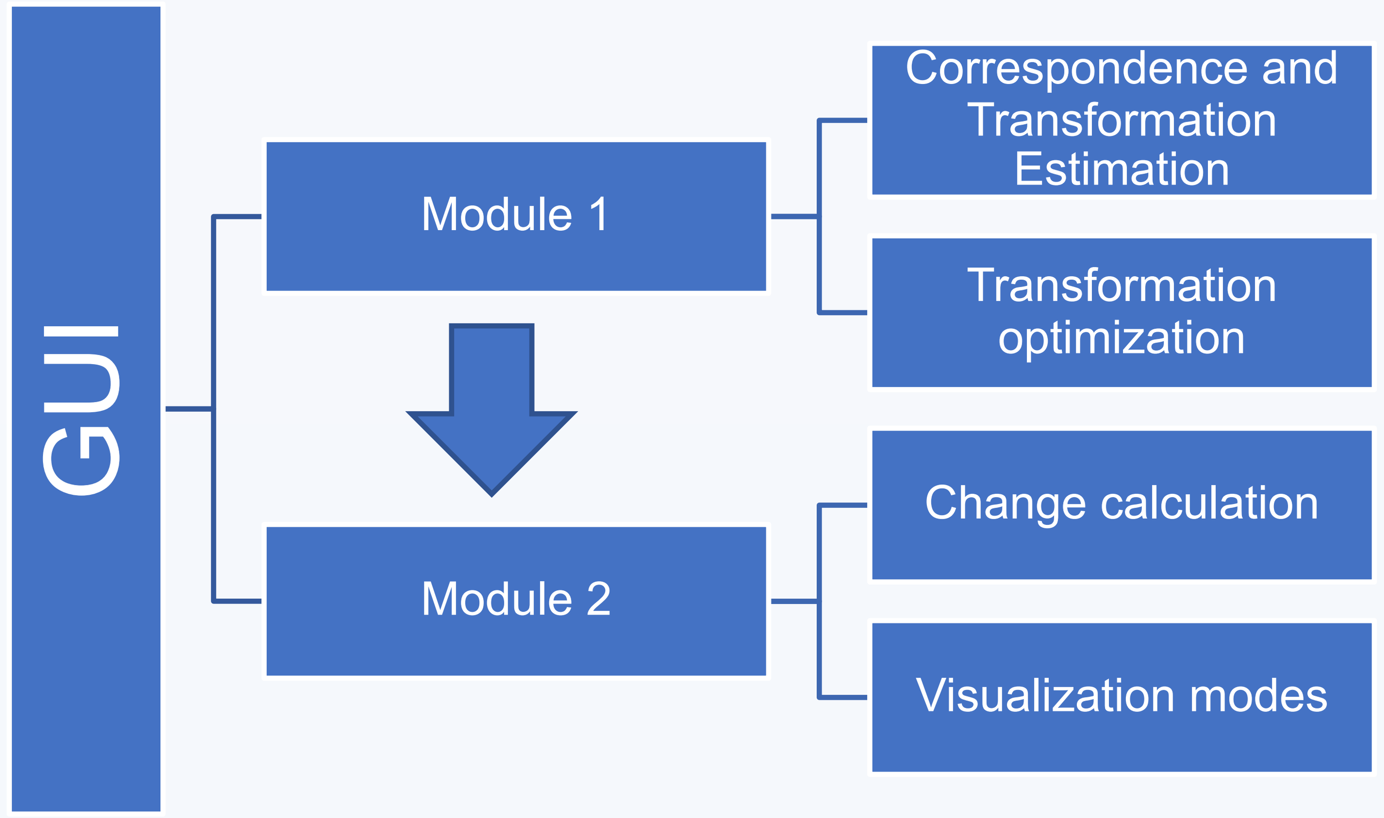
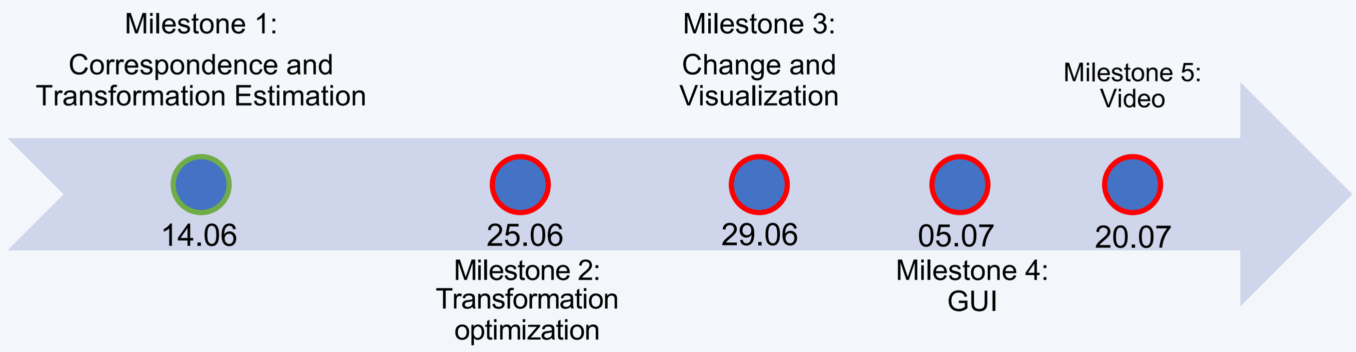



Figure 3: Software architecture of the proposed algorithm setup.

## TIMELINE




## WORK DISTRIBUTION

- R. Jacumet is working on the transformation estimation pipeline and has already written a functionality for the visualization of differences.
- M. Schneider works on an alternative approach for the transformation estimation pipeline based on the 4-point algorithm.
- A. Misik supported the team in the correspondence pipeline and works on the change, visualization and the GUI.
- O. Inak works on the optimization of the correspondence pipeline and is expanding the functionalities of the change and visualization pipeline.
- All team members will be contributing to the project documentation and video creation.

## PROBLEMS

Several problems have been identified during the project conception and first experiments:

- For some image pairs, feature-based correspondence is not possible due to the high degree of image perturbation.
- In some cases, the reconstruction of the transform between image pairs is not possible because there are not enough correspondence points.
- An optimal method for visualizing urban/rural/sea differences between images has not yet been found.
- Runtime of both modules needs to be optimized.

## REFERENCES

[1] H. Bay, T. Tuytelaars, and L. Van Gool. Surf: Speeded up robust features, in European conference on computer vision, pp. 404-417, Springer, 2006.

[2] P.H.S. Torr and A. Zisserman. MLESAC: A New Robust Estimator with Application to Estimating Image Geometry, *Computer Vision and Image Understanding* 78, no. 1 (April 2000): 138–56. https://doi.org/10.1006/cviu.1999.0832.

[3] N.Dey, S.Dutta, G.Dey, S. Chakraborty, R.Ray and P.Roy, (2014). Adaptive thresholding: A comparative study. 2014 International Conference on Control, Instrumentation, Communication and Computational Technologies, ICCICCT 2014. 10.1109/ICCICCT.2014.6993140.