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Detection of People and Motion Analysis in Aerial Image Sequences

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Abstract

The subject of the presented research project is the development of suitable methods for the detection of people and the analysis of their motion in aerial image sequences. In this poster we give an overview of the overall system and the available data. Furthermore we deliver insights into the modules for object detection, object tracking and density estimation and show some qualitative results.

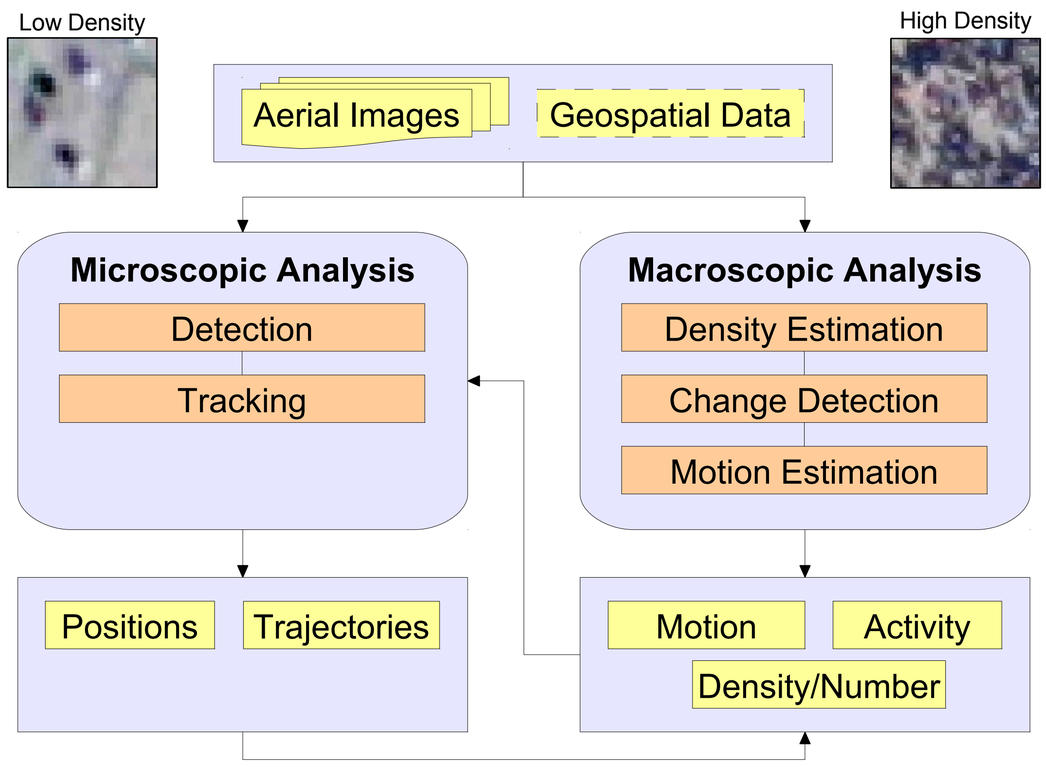
1. Introduction

Aerial image sequences taken from high altitude allow to quickly overview wide areas and to analyze temporal changes. The presented research project aims to develop automatic methods for the detection and tracking of persons in these sequences [2]. The results are e.g. useful in the following applications:

- Monitoring big events and people in crowded scenarios
- Tracking individuals and generating motion data on a large scale
- Supporting relief units in case of emergency
- Evaluating infrastructure

2. System Overview

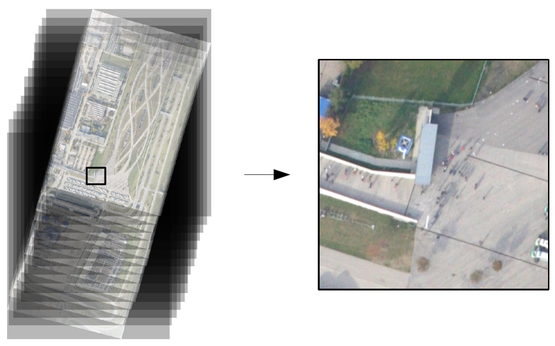
The system is divided into two parts to account for varying object density and image resolution. The microscopic analysis works on the object level while the macroscopic analysis works on the pixel or block level.



3. Data

The properties of aerial image sequences differ a lot from terrestrial videos and have to be accounted for during image analysis [1]:

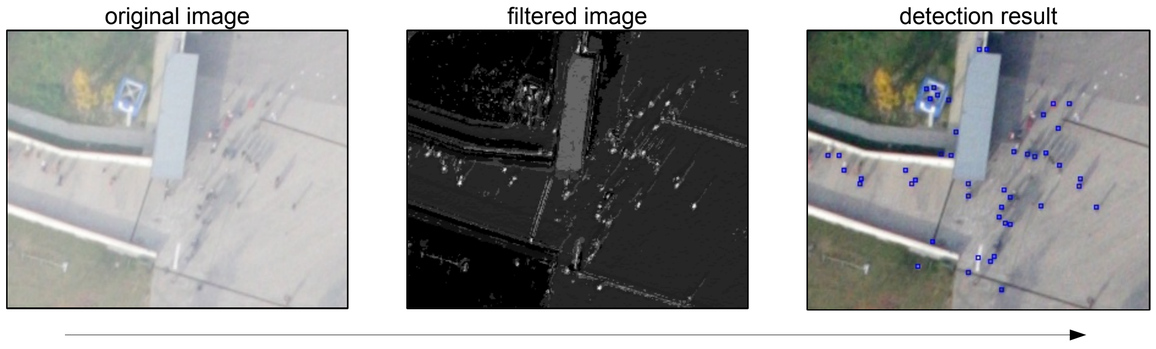
- Image size 4000 x 5000 pixel
- Pixel size 15cm - 45cm
- 4 - 16 frames per sequence
- 2Hz frame rate
- Moving camera platform
- Preprocessing steps
  - direct georeferencing
  - orthorectification



4. Object Detection

The detection module has to cope with low resolution and difficult lighting conditions. We choose an appearance-based detection approach:

- Object-specific filter mask (object detector)
- Haar-like features, color features → AdaBoost classifier
- shadow normalization → filtering → segmentation → thresholding



5. Object Tracking

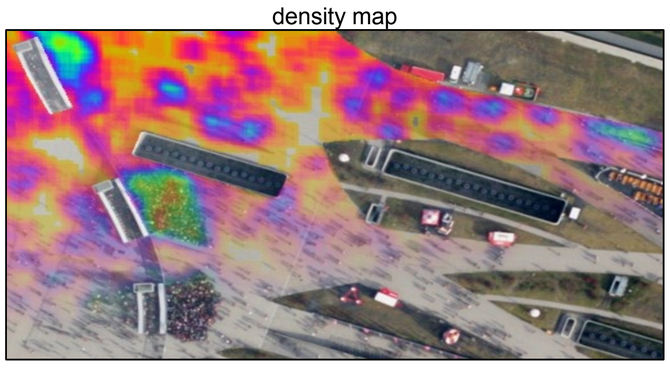
Tracking is challenging because of uncertain detection results, low frame rate and high number of objects in close proximity. We utilize a tracking-by-detection approach:

- Recursive bayesian tracking framework
- Near constant velocity motion model
- Efficient gating within tree structure
- Global nearest neighbor data association
- Kalman filtering

6. Density Estimation

Estimation of object density can be done after object detection. Yet if the resolution is too low or the scene is too crowded, the local density is calculated qualitatively on the pixel level and density maps are produced.

- Back-/foreground segmentation
- Region-growing
- Edge detection
- Shape analysis
- Dot filtering



7. Future Work

- Improve existing modules e.g. multiple hypothesis tracking, ...
- Develop missing modules
- Connect microscopic and macroscopic analysis to stabilize and improve results

References

[1] Thomas U., Rosenbaum D., Kurz F., Suri S., Reinartz P., *A new software/hardware architecture for real time image processing of wide area airborne camera images*, Journal of Real-Time Image Processing, 2008, 4(3):229-244.

[2] Burkert F., Schmidt F., Butenuth M., Hinz S., *People Tracking and Trajectory Interpretation in Aerial Image Sequences*, International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, 2010, Vol. XXXVIII, Part 3A, 209-214.