Airborne Target Tracking Using Visual and IR Cameras

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Overall goal

Provide a (semi-)autonomous airborne surveillance platform. This includes solving the following highly relevant practical and theoretical subproblems:

- ✘ Target tracking and classification based on video and IR video
- ✘ Navigation and pose estimation from GPS, IMU and video
- ✘ Dealing with low-quality sensors for cost efficiency
- ✘ Collaboration between unmanned airborne platforms
- ✘ Trajectory planning for best possible utilization of platforms

Application

An application where these goals are of interest is in the surveillance of national parks:

- ✘ Automatic tracking of animals within the park
- ✘ Border monitoring for early detection of poachers and intruders
- ✘ Surveillance both from semi-stationary and moving platforms
- ✘ Provide aerial images for park rangers

MHT output for extended target tracking in IR video

MHT output for tracking dolphins using stationary camera

Initial approach

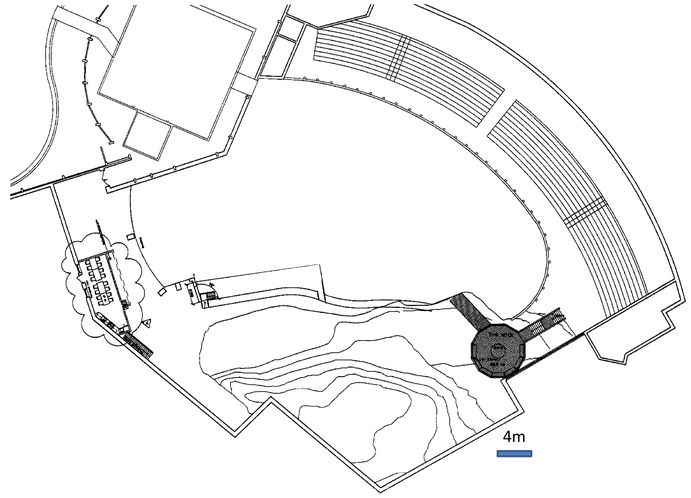
The approach is to start looking at simple cases and then increase complexity by combining and augmenting solutions. Currently the following initial approaches are investigated:

- ✘ Use of Kolmården wildlife park as a test site from where real data is collected
- ✘ Animal tracking in world coordinates with dynamic model using a stationary camera
- ✘ Animal tracking from a moving platform
- ✘ Evaluation of different pre-processing methods
- ✘ Evaluation of different tracking algorithms

Challenges and possible solutions

For the initial approach the following challenges have been encountered and possible solutions are tested:

- ✘ Extended target tracking using Gauss-Inverse Wishart model
- ✘ Estimation of intrinsics for moving camera
- ✘ Estimation of simplified intrinsics, distortion and extrinsics for mapping image to two dimensional map
- ✘ Segmentation through thresholding in IR video
- ✘ Background/foreground segmentation in stationary video using Gaussian mixture model



Map according to scale for tracking dolphins

Future Work

- ✘ Collect more data from Kolmården using video, IR video, GPS and IMU
- ✘ Track in world coordinates using a calibrated camera and estimates of position and pose
- ✘ Employ suitable dynamic models to improve tracker performance
- ✘ Track extension of target in world coordinates for classification
- ✘ Use output from tracker to improve image segmentation
- ✘ Use video and IR video to improve localization and pose estimation
- ✘ Combine with work of Per-Johan Nordlund for distributed sensor fusion
- ✘ Combine with work of Zoran Sjanic to improve navigation and tracking performance