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Airborne Sensor Platforms for Surveillance of Smart Savannahs

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Introduction and Background

The security situation in many countries in southern Africa is poor, and it has been identified that one approach for improving the stability is to target poaching in the wildlife reserves. Partly, the money earned through poaching often ends up financing organizations that contribute to the instability and improving the ability to protect a reserve against intruders is a stepping stone to improving the overall border protection of countries. The Vinnova project Smart Savannahs aims at providing Project Ngulia with innovative cost-efficient technology by using airborne sensor platforms to search for intruders in order to alert command and control in good time, as well as to provide situation awareness by tracking endangered animals within the reserve.

To develop and evaluate various aspects of the unmanned solution Kolmården Wildlife Park is used as a test facility. Their savannah is populated by rhinoceros as well as other non-endangered animals and is partly surrounded by vegetation, providing a good simulation of an actual scenario.

Figure 1: Thermal camera(top) and camera(bottom) images of a rhinoceros and an intruder.

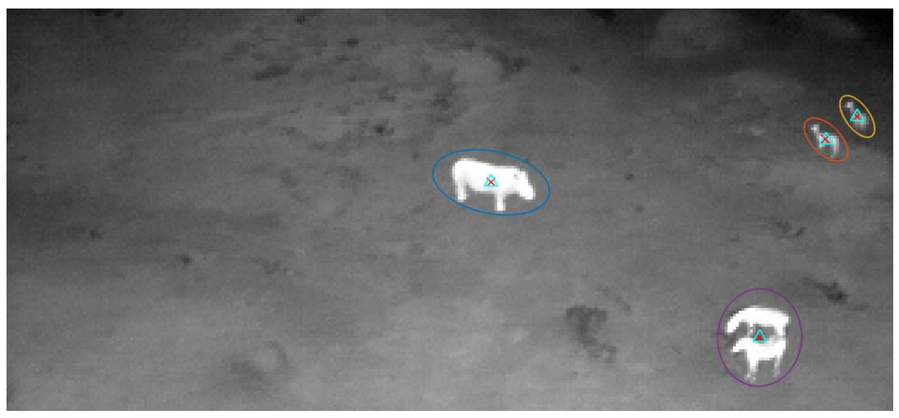


Figure 2: Extended target tracking applied to thermal camera images.

Target Tracking Platform

As aerial platforms:

- **Balloons** can be used as low maintenance permanent solutions.
- **Fixed-wing aircrafts** can be used to cover large areas.
- **Rotorcrafts** can be used for shorter missions.

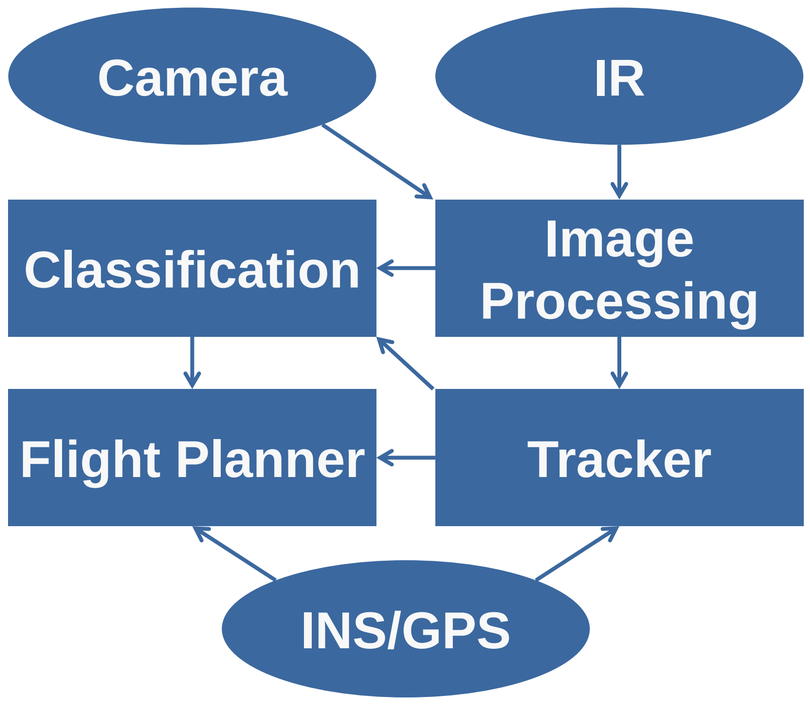
To detect animals and intruders:

- A **thermal camera** is used for day and night surveillance.
- A **camera** is used to aid in classification during the day.
- **Image processing** is used to extract information of possible targets.
- **Classification** based on both image processing and tracking results is used.

To locate animals and intruders:

- An **INS/GPS** is used to locate the platform's own position.
- **Camera models** are used to relate detections to positions on the ground.
- A **multi-hypothesis target tracker** [1] with an **extended model** [2] is applied to correlate detections over time and track the absolute positions and sizes of targets.

To further improve the solution also the ground is modelled and the cameras are used to improve the attitude estimate. The tracking and classification results are passed to a flight planner determining an appropriate path.



Acknowledgments

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References

[1] S. Blackman and R. Popoli, Design and Analysis of Modern Tracking Systems, ser. Artech House radar library. Artech House, 1999.

[2] W. Koch, Tracking and Sensor Data Fusion: Methodological Framework and Selected Applications, ser. Mathematical Engineering. Springer Berlin Heidelberg, 2013.