MÖTESPLATS
SAMHÄLLSSÄKERHET
KISTAMÄSSAN 28-29 NOVEMBER 2017

LINKÖPING UNIVERSITY

Outline of a Multi-Agent Surveillance System

C. Veibäck[1], **J. Olofsson** [2] **and G. Hendeby**[1]
[1] Linköping University, Linköping, Sweden, [2] Norwegian University of Science and Technology, Trondheim, Norway

Relevance

A design of a system for tracking sea ice using multiple agents is proposed in [1]. This is one example of surveillance of critical infrastructure and the design is here generalized to a broader class of surveillance problems.

Introduction

The need for monitoring of critical infrastructure, large gatherings of people, or other high profile areas is constantly increasing. The purpose of the surveillance may vary greatly, from protection against hostile intruders to achieving situational awareness in areas populated by humans, vehicles or animals. Oftentimes the area of interest is too vast or too remote to be covered by traditional sensor networks, demanding a new approach to surveillance. The system must be able to deploy, interface, and organize multiple types of mobile sensors more or less autonomously. This work proposes a modular, scalable and extensible design of a general multi-agent surveillance system as illustrated in Fig. 2, where tracking, analysis and control have been separated. The aim in the coming years is to evaluate the original system design on Svalbard.

Sensors

Many different sensors and sensor platforms can be used for surveillance. For the purpose of the suggested design they are categorized with respect to their mobility:

- **Stationary sensors** with known, fixed position and field-of-view, such as ground-based radar or surveillance cameras.
- **Traceable sensors** with known but not fixed position and field-of-view, albeit not controllable, such as satellites.
- **Controllable sensors** with known position and field-of-view, with the ability to be commanded to new locations, such as *unmanned areal systems* (UASs).

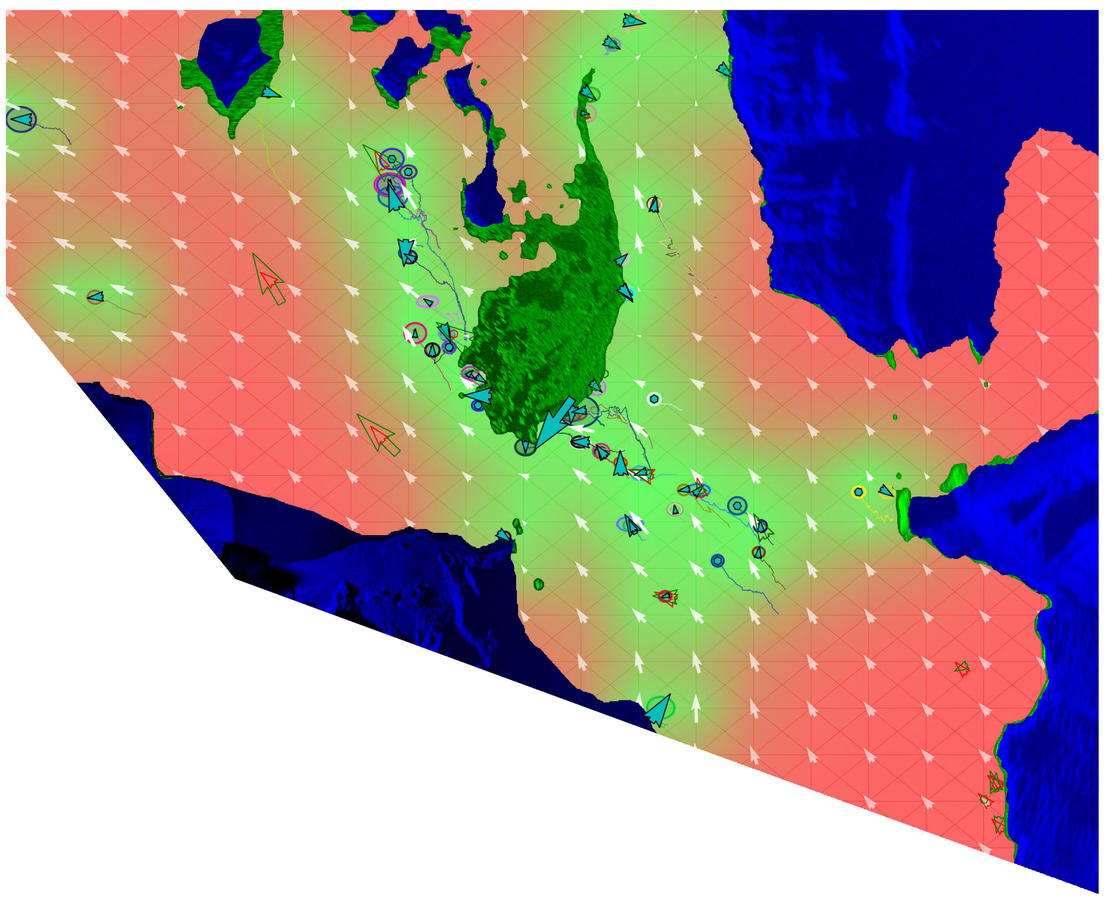

Figure 1: Example of data fusion and a situation map. Trajectories of sea ice is shown with uncertainty and heading. The white arrows show estimated current and the green-red background shows the information quality.

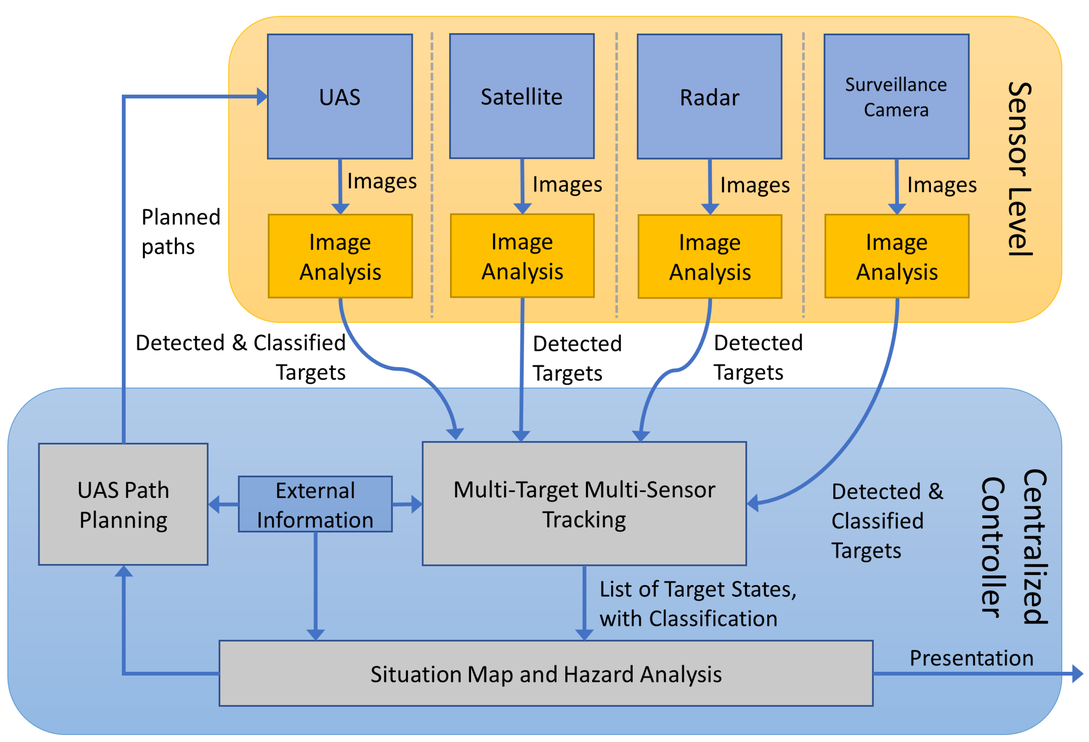

Figure 2: System design

Mission Control

Data Fusion: One role of the controller is the fusion of information from all sensors into a combined map of targets, see Fig. 1.

Situation Maps: Another role of the centralized controller is to form coherent situation maps from all information available, see Fig. 2. Components that could be included and combined while taking the quality of the information in consideration are:

- Tracks;
- Terrain information;
- Sensor locations;
- Traffic information; and
- Weather conditions.

Path Planning: A third role of the controller is to coordinate and command the mobile sensor platforms, e.g. UASs. Control of mobile platforms is a multi-level control problem, and whereas low-level control is left for each agent, the situation awareness of the centralized controller is used to give the agents high level instructions [3].

Acknowledgements

The project is supported by grants from European Union's Horizon 2020 research and innovation programme, the Vinnova Industry Excellence Center LINK-SIC and Swedish strategic research center Security Link.

References

[1] J. Olofsson, C. Veibäck, G. Hendeby, and T. A. Johansen, "Outline of a system for integrated adaptive ice tracking and multi-agent path planning," in proceedings of 2017 RED-UAS, Linköping, Sweden, 2017.
[2] F. Gustafsson, Statistical Sensor Fusion, 2nd ed. Lund, Sweden: Studentlitteratur, 2012.
[3] P. Skoglar, "Tracking and Planning for Surveillance Applications," Dissertations No 1476, Linköping Studies in Science and Technology, 2012.

Linköping University – www.liu.se:
Contact: clas.veiback@liu.se

SECURITY LINK
RESEARCH • EDUCATION • INNOVATION