



Multi-target tracking by non-linear set-membership methods

Soutenance de thèse – Julius Ibenthal

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Amphi I, Bâtiment Eiffel, CentraleSupélec, 3 rue Joliot-Curie, 91190 Gif sur Yvette.

Participation online or in person. Registration link for online participation:

https://teams.microsoft.com/registration/u_7NaHsVRki6L9GWqRJKwA,m0iH0gtYf06fGgI-jke9jw.B119PPH3nEO81xyFowkGHA.Voo0Nb5wk0Oa4HM0AZCSGg.hkVJtKEpnkK5txiatOo9iA,73QRZkRX7UqAiuLfNpIqQ?mode=read&tenantId=68cdfebb-157b-4846-ba2f-d196a9124ac0

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Abstract : Searching and tracking mobile targets remains a challenging task among the various applications for robots. This thesis considers the search and track of an unknown number of targets moving in a bounded area by a fleet of cooperative Unmanned Aerial Vehicles (UAVs). Distributed estimation and control schemes are presented. The estimation schemes rely on the assumption that state perturbations and measurement noises are bounded. Robust distributed set-membership estimators are used to evaluate set estimates that are guaranteed to contain the target states. The set estimates are updated by each UAV using information collected from its sensors and from the neighboring UAVs. The trajectories of the UAVs are designed using model predictive control approaches. The control is designed to decrease the estimation uncertainty of the unknown, not yet detected targets and known, tracked targets.

The developed estimation and control schemes rely on new detailed models of deterministic identification and detection conditions of the targets. These conditions account for UAV and target states, sensor constraints, and environmental obstacles. The developed estimators utilize measurements of identified and unidentified targets and are robust to the presence of potential decoys, which may be confused with the targets. Furthermore, the new deterministic detection model allows the evaluation of guaranteed set estimates of target locations in unknown structured environments, where it is challenging to demonstrate the absence of a target at a given location. To estimate the target locations, neither having nor building a map of the environment is necessary.

Various simulations illustrate the ability of the proposed approaches to efficiently search and track an unknown number of moving targets within some delimited search area. Additionally, preliminary experimental studies are carried out.

Keywords: Multi-agent systems; Set-membership state estimation; Cooperative distributed control; Multi-agent systems; Multi-target tracking