

PhD Thesis Description

1. Title

SUIVI ET IDENTIFICATION DES CIBLES RADAR UWB

2. Supervisors

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- Co-supervisor: ---
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3. Description

3.1. Context

To make cars smarter and connected, new modules based on UWB (Ultra-Wide Band) technology have been introduced in cars for short-range applications (up to 10 m). These modules can be used in communication mode (communicating with a smartphone, for example), but also in radar mode.

3.2. Objective(s)

The aim of this thesis is to exploit the radar function of the various UWB modules installed around and inside the car to detect, track and identify targets (pedestrians, for example) or certain gestures performed or vital signs of a user. This should lead to several automotive applications, such as target detection in dead zones, parking assistance, emergency braking, intrusion detection, gesture recognition or biometrics.

Initially, a state of the art on the various UWB radars will be presented, including impulse, MIMO and SAR (Synthetic Aperture Radar) radars. This will include the detection methods used to estimate parameters such as range, speed, angle of arrival, RCS (Radar Cross Section), etc. A state of the art on FMCW (Frequency Modulated Continuous Wave) radars (60 GHz) will be presented for comparison with UWB radars.

Target localization and tracking algorithms will then be developed using UWB radar. Different cases will be studied: using 1 single radar, using several radars, detecting one target, detecting several targets, detection when the vehicle containing the UWB modules is stationary and when it is moving.

The thesis will then focus on obstacle identification and gesture recognition, by developing parameter extraction and automatic classification algorithms.

Finally, the thesis will focus on vital signs monitoring and biometric applications.

Combination with other components of the technologies used in cars, such as the communication mode of the UWB module, V2x, GNSS, accelerometer, camera or other sensors could also be investigated to improve performance in localization, tracking and identification. To this end, data fusion algorithms would be studied, bearing in mind that data fusion shares similar methods with target tracking.

3.3. Work Plan

- State of the art on UWB and FMCW radars
- Development of detection methods to estimate radar parameters: range, Doppler, angle, RCS etc. using pulsed UWB, MIMO and/or SAR radar

- Development of a real-time algorithm that uses the various estimated parameters to locate and track targets using methods such as clustering and Kalman filtering
- Propose methods for extracting parameters characteristic of targets and user gestures
- Propose methods for extracting characteristic parameters from vital signs and biometrics
- Development of radar classification methods using Machine Learning techniques
- Combine UWB Radar with other vehicle components to improve UWB Radar performance

3.4. Keywords

Radar, UWB, estimation, detection, filtering

3.5. References

4. Doctoral School

EDMITT (?)

5. Research Unit

Université Savoie Mont-Blanc

6. Proposed Funding

- CIFRE Continental (Full funding, private company, to be confirmed)