BAKKALAUREATSARBEIT/ MASTERARBEIT

JOHANNES KEPLER UNIVERSITÄT LINZ

INSTITUT FÜR NACHRICHTENTECHNIK UND HOCHFREQUENZSYSTEME

Topic:

Design and realization of a target for extrinsic radar-camera-calibration

Figure 1 Combination of a radar sensor (bottom) and a stereo camera (top).

Motivation and Goal:

Radar sensors and stereo camera can both be used to detect objects and estimate the position relative to the sensor. Due to the different sensory principle, accuracies and detection capabilities are vastly different, e.g. cameras have high slant resolution while radar sensors outperform stereo cameras in distance estimation. In real-world measurement scenarios, e.g. for autonomous driving, a combination of both sensors is desired. As a preliminary step for data fusion, the sensors needs to be calibrated mutually. The goal of this thesis is to design and realize an object than can be identified easily and with high accuracy by both, a radar sensor and a stereo camera. Based on measurements using the calibration object, extrinsic calibration parameters for the sensor fusion should be obtained. Finally, the merits of combining calibrated data from a stereo camera and a radar sensor should be demonstrated by tracking the calibration object (turn-tables and linear rails for reproducible trajectories are available) using either sensors separately and in combination by employing a simple Kalman-filter-based single target tracker.

Scope Part-1: **Design and realization of a calibration target**

Beginning with literature research on radar and camera calibration techniques and already existing designs for calibration targets, either an existing design should be selected or a new design should be proposed. The calibration target will then be manufactured. Radar sensors and stereo cameras are readily available at the institute as well as a semi-anechoic chamber to conduct calibration measurements. Based on these measurements, extrinsic calibration parameters should be obtained.

Scope Part-2: **Demonstrate the merits of having calibrated sensors**

Once calibration is done, the merits of combining calibrated data from radar sensors and stereo cameras should be demonstrated. A Kalman filter approach provides for easy combination of data from different sensors with different rates and accuracies. Using available linear rails as well as turn tables in our semi-anechoic chamber, a defined dynamic scenario can be generated. Firstly, the Kalman filter for single target tracking should be used to estimate the trajectory using the radar sensor and the camera separately. Secondly, it should be demonstrated how the quality of the trajectory estimate improves when the radar sensors' and the stereo camera's calibrated data are used in combination.

The topic of combined tracking with a stereo camera and a radar sensor can potentially be used as base for a subsequent master thesis.

Start: from now on (November 2020)

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