

Camera-Assisted Localization of Passive RFID Labels

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ABSTRACT

Besides its main task of identifying objects Radio Frequency Identification (RFID) can also be used for localization. However, in many applications the localization is challenging (e.g. high number of tags, harsh environment) and requires advanced hardware. A localization approach only based on a camera can provide high localization accuracy, but has the disadvantage of a small coverage area. Combining camera-based and RFID-based localization increases localization accuracy with only a small cost increase for the off-the-shelf camera compared to a purely RFID-based localization and overcomes the need for specialized RFID hardware.

To obtain this low-cost high-precision localization environment Received Signal Strength Indicator (RSSI) values of passive RFID labels are combined with a camera-based localization approach in a Constrained Unscented Kalman Filter (CUKF). The camera based localization is done via “Back Projection” method while the RFID localization is done based on the measured RSSI values which are transformed into distances. Because the height of the tag on the object is known this information can be used as a constraint in the localization process. A second constraint is that if the object is not found in the camera image the object’s position has to be outside of this region and the other way around.

To verify this localization approach objects tagged with an RFID label are moved in the coverage area of the camera and the RFID antennae. The accuracy of the localization is improved due to the camera-based localization information because of its high location accuracy compared to the rather noisy RSSI measurements of the RFID-based localization. The results show that it is possible to reduce the localization error of the RFID localization with the help of the constraints and the camera localization by a factor of about four.

KEYWORDS: RFID, localization, camera, Unscented Kalman Filter