Indoor positioning system for high dynamic applications

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ABSTRACT

This extended abstract is submitted as an entry to the Microsoft Indoor localization competition that will take place in April 2018. Our entry is for the infrastructure-based modified Commercial off-the-shelf technologies category. The RACELOGIC indoor positioning system is based on bespoke UWB firmware and hardware for high dynamic applications and is intended to output position & velocity measurements at 100Hz with minimal latency.

1 INTRODUCTION

RACELOGIC products are used by automotive OEM's, primarily to measure the position and velocity of a moving vehicle to a very high degree of accuracy using GNSS measurements on an outdoor test track. The precise position and velocity are used for testing and validating vehicle dynamics, brake testing, tyre testing, ADAS and many other automotive applications. Currently many of our customers want to have the freedom to test the vehicles in an indoor test track as well, for which an indoor positioning system is needed.

In most of the currently available indoor positioning systems, the typical output rate is up to 10 Hz as they are mostly focused on estimating the position of slow moving objects/people i.e. low dynamic applications and most of them don't compute velocity. Also the position is usually computed in a central location. But in our application we need to estimate both the position and velocity of highly dynamic vehicles in an indoor test track accurately at the vehicle itself. Many different approaches have been proposed for indoor positioning using different technologies (such as Radio Frequency signals, Light, Sound, Magnetic Fields etc) which use different techniques such as Trilateration, Time of Arrival, Time Difference of Arrival, Angle of Arrival, Received signal strength, Fingerprinting [1]. Our approach to solving this problem is based on using UWB transceivers with bespoke hardware including antenna, and firmware so that the position can be estimated with an accuracy of 5cm (1σ) in ideal conditions with an output rate of 100 Hz.

2 OUR APPROACH

In our application, the task is to localise a vehicle which may be performing high dynamic maneuvers on an indoor test track. Towards this objective we propose to use the trilateration technique using UWB transceivers. This approach involves installing UWB beacons (referred to as *anchors*) with bespoke antenna and firmware in the the test facility (i.e. fixed infrastructure) along with a UWB beacon installed in the car (referred to as *rover*) which needs to localise itself i.e the position and velocity are computed at the rover itself.

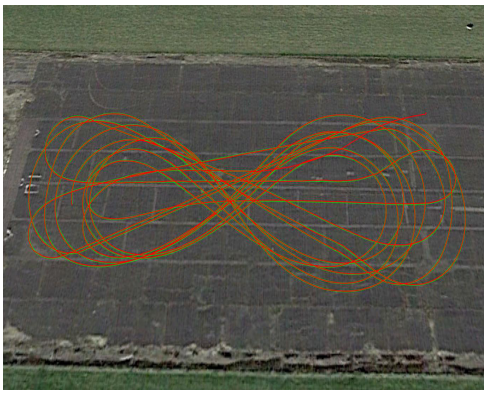

Figure 1: Outdoor testing UWB (red) & RTK GNSS (green).

This simplifies the installation of the system significantly and minimises the latency of the outputs. Both the anchors and the rover are powered using batteries.

Our setup requires at least 6 UWB anchors to be visible to the UWB rover for the system to localise itself. It is also assumed that the location of the anchors can be surveyed and given as an input to the UWB rovers. In the current version of the prototype, the UWB rover can use up to 10 UWB anchors. In the final version of the product, the rover will be able to select the best subset of anchors in an installation potentially containing hundreds of anchors.

CONCLUSION

The current prototype was mounted in a car and has been tested in both outdoor and indoor test tracks. In the outdoor test track the UWB position estimate was compared against GNSS RTK position (+/-2 cm) and the accuracy of the UWB system was found to be within 5cm (1σ) as shown in figure 1. In the indoor test track the accuracy of the system was confirmed by stopping the car in two predetermined points and measuring the distance between them. The accuracy was still found to be better than 5cm (1σ). Future work will involve integrating the UWB positioning system with current RACELOGIC data logging products so that this system can be deployed seamlessly by our customers.

REFERENCES

[1] Ramon F. Brena, Juan P. GarcÃŋa-VÃązquez, Carlos E. GalvÃąn-Tejada, David MuÃśoz-Rodriguez, Cesar Vargas-Rosales, and James Fangmeyer Jr. [n. d.]. Evolution of Indoor Positioning Technologies: A Survey. *Journal of Sensors* 2017 ([n. d.]). https://doi.org/doi:10.1155/2017/2630413