

Mobile Doppler Bearing System

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Today's portable passive bearing systems consist of huge receiver structures as directive antenna and analog receivers. Most of their tracking results are imprecise and not determined on a geographic map. Many tracking applications (e.g. animal tracking) require highly mobile and flexible system structures. The purpose of this master thesis is to develop an inexpensive and accurate mobile bearing system implemented as a software defined radio receiver. The system's application area includes the tracking of stationary and highly maneuvering radio frequency (RF) transmitters within a moving vehicle.

Introduction

Nowadays bearing system market doesn't provide mobile, accurate and low power consuming bearing solutions at a low price level. So far, only analog pseudo doppler systems have been developed. A pseudo doppler bearing system as a software defined radio seems to be a novel approach. As a single chip solution we can obtain a small and robust receiver structure with reduced costs and better bearing results.

A direction-of-arrival estimator for RF signals was developed in a preceding project. Within this master thesis the estimator is extended to a bearing system in a moving vehicle. Due to this posi-

tion shift, the bearing system requires only one smart antenna to estimate the position of the RF transmitter.

Objectives

We have focused our attention on the development of a robust bearing algorithm and the associated experimental hardware. The design of the receiver structure allows minimizing the analog hardware. We attach importance to cost and prototype-friendly design of the entire system.

Hardware

The entire system consists of a smart antenna and a software defined radio receiver. The en-

tire analog signal preprocessing (switching, amplification, filtering) is performed by the smart antenna electronics. The receiver arrangement is first designed as a functional model.

Triangulation Algorithm

Triangulation is the process of determining the location of the RF transmitter by measuring noise corrupted angle information to it from known observer points. However the distance from the observer to the target is not observable and a highly non-linear problem. The estimation of the distance is performed by a sequential Monte Carlo estimation technique also referred as particle filter. We have implemented a particle filter that approximates the probability density of the RF transmitter's position.

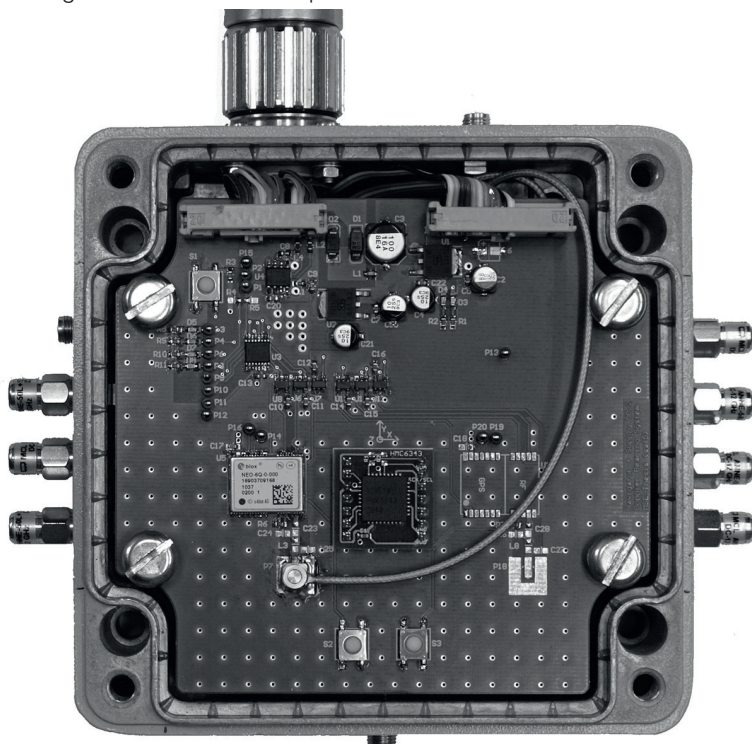
Conclusion

The integration of a bearing system into a single chip solution is an adequate solution for minimizing the overall system costs and size. This thesis demonstrates a competitive alternative to existing bearing systems.

Future work will include the development of demodulation techniques that allows the extraction of information from the RF signal during the bearing. Multi-target tracking is also a conceivable extension.



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Navigation PCB of the smart antenna electronics. This view obscures the RF print underneath.