EasyPoint – Indoor Localization and Navigation Low cost, reliable and accurate

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ABSTRACT

In this paper, we describe EasyPoint, a low cost, reliable and accurate System for indoor localization and navigation. Between a tag and several low-cost EasyPoint (anchor nodes) the distances are calculated with a high-resolution spectral method by analyzing the measured phase differences of a set of 2.4 GHz frequencies. The position is shown in an app on a mobile device connected via Bluetooth to the tag.

Keywords

Indoor navigation, phase and distance measurement

1. INTRODUCTION

The consequent further development of the Lambda:4 technology for distance and direction measurement was ended up in a low cost indoor-localization-technology [1]. By using the 2,4 GHz frequency it is possible to use low cost chips and to integrate the Lambda:4 technology in existing standards (Bluetooth, WiFi, ZigBee)

2. HARDWARE

The used hardware consists of three components. The easy to deploy anchor nodes “EasyPoint” are multi-antenna-systems: The Tag “Rex” is communicating with each anchor node to measure each distance. The calculated distances are sent via Bluetooth to an Android mobile device. In an App on the mobile device the position will be calculated by using the distances and the anchor node positions. The position is displayed in a Google Map.

Figure 1. Hardware Prototypes anchor node “easyPoint”, tag “Rex” and mobile device with app

3. DISTANCE MEASUREMENT

The distance measurement can be performed between two transponders or between one station S1 - also called receiver and one transponder T1. [2]

A set of individual phase measurements is provided on different successive discrete frequencies. The individual phase measurements then constitute the basis for calculating the distance by means of mathematical methods.

Each individual measurement sets up a simulated (functional equivalent) ‘standing wave’ between station S1 and the low-cost transponder T1. The patent protected method achieves the same result as if:

1. the unmodulated carrier of station S1 were transmitted to transponder T1,
2. there were an active (amplified) reflection in T1 and
3. the reflected signal were mixed with the emitted signal in station S1 and measured as a complex I/Q value.

The phase as measured (I/Q) is then constant (in a constant frequency and an unmoved system).

The phase as measured (I/Q), however, changes upon variation of the frequency (wave length) in direct proportion to the distance (ideal case without multipathing).

4. PILOT PROJECTS AND RESULTS

The high accuracy of the system was demonstrated a couple of times, e.g. at the WPNC ’13 in Dresden. In an area of about 650m², with only six low cost “EasyPoint 20” through walls and closed doors we achieved an average accuracy of 1,26m. [3]

5. FUTURE ASPECTS

With the phase measurement feature, which will be in upcoming Bluetooth standards, the main step to integrate also the distance measurement is done. Consequently the distance measurement will be implemented and becoming a mass market capable feature for indoor localization.

6. REFERENCES

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