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HOCHSCHULE BREMEN
UNIVERSITY OF APPLIED SCIENCES

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Ivan Artamonov

On the use of Software Defined Radio Receivers for GNSS Signal Reception

ABSTRACT - Masterthesis

Software-defined radio (SDR) is a communication system where some parts of the system typically implemented in hardware can be implemented in software. The main idea behind SDR is to move transition between analog domain and digital domain closer to the antenna. This type of receivers provides flexibility and adaptability.

The Global Navigation Satellite System (GNSS) positioning accuracy has been studied during the last decades. In order to investigate a factors, which are influence on positioning accuracy, can be used the SDR receiver, instead of inflexible proprietary devices. This kind of receivers offers the possibility to have direct access to the raw satellite signal. Therefore, it would be possible to perform an analysis of the received signal and extract as much as possible information about the channel.

In this work developed and utilized the low-cost Universal Software Radio Peripheral (USRP) and R&S®TSMW Universal Radio Network Analyzer. These devices were used for recording of the GNSS signals. Further, a free Global Positioning System (GPS) receiver implemented in MATLAB by Borre et al. was used in combination with the existing hardware. Then additional programs were developed in MATLAB and C++API to satisfy all the requirements of the software-defined receiver.

After the measurements, the carrier-to-noise density ratio estimated for every acquired satellite. This parameter is useful for further investigation of a positioning bias. The positioning bias is influenced by many factors. Some of them are the propagation of the satellite signals through different paths until reaching the GNSS receiving antenna and ionospheric scintillations. The multipath propagation of satellite signals has to be investigated under the framework of the German project BERTA. This thesis provide hardware, software and measurement campaign for future analysis of the multipath propagation.