

Properties of USRP2 in Communication Applications

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Dynamic Spectrum Access (DSA) and Cognitive Radio (CR) are two methods of achieving efficient spectrum utilization. FOI is developing DSA algorithms based on intersystem interference analysis tools. To show gains of using DSA as compared to non-DSA systems, e.g., increased interference resilience, the algorithms will be demonstrated using the Universal Software Radio Peripheral 2 (USRP2) [1] and the companion GNU Radio software package [2].

In this work we evaluate the URSP2's suitability for DSA and communication applications by determining RF, software and hardware properties of the URSP2. Within the Dynamic Telecommunication project we will also evaluate the URSP2's suitability for high data rate communications, e.g. IEEE 802.11g.

The USRP2 provides significant improvements compared to its predecessor, the URSP [1]. The speed and resolution of the analog to digital and digital to analog converters (ADCs/DACs) have been improved. More importantly, the communication between the USRP2 and the host computer uses Gigabit Ethernet instead of USB 2.0. Theoretically, this allows the USRP2 to handle signal bandwidths of up to 100 MHz. In an implementation of IEEE 802.11b the data rates were limited to 1 and 2 Mbps, and the Barker code could not be implemented on the transmitter, due to the limitations of USB 2.0 [3].

URSP2 also provides greater support for on-board signal processing and stand-alone applications due to a more powerful FPGA. Unfortunately, the GNU Radio software is not yet as developed as for URSP.

In this work we measure RF properties of the USRP2/GNU Radio combination¹, comparable

to the measurements in [4]. We also evaluate timing properties of URSP2, e.g. time difference between multiple USRP2's in MIMO or triangulation applications.

Improved signal bandwidth is a major improvement from the USRP and we determine the actual frequency range, and whether the limiting factor is the ADC or the USRP-host communication. For spectrum measurements, the linearity and existence of spurious components are important factors and we investigate how quickly the centre frequency can be altered in case of insufficient bandwidth.

Other imperfections of the URSP have been reported [5] and we have also observed a significant variation between different boards of same type. It remains to be seen if this has been remedied with the USRP2.

- [1] Universal Software Radio Peripheral <http://www.ettus.com/>
- [2] GNU Radio, the gnu software radio <http://www.gnu.org/software/gnuradio>
- [3] Implementation of IEEE 802.11b http://gnuradio.org/trac/wiki/BBN_Technologies_Internetwork_Research_ADR_OIT_Project
- [4] H. M. Tullberg, M Asplund and M Alexandersson, "Spectral Properties of an SDR using Universal Software Radio Peripheral," in Proc RFMTC 2007, Gävle, Sweden, 2007.
- [5] Peter Händel, Per Zetterberg, "Receiver IQ Imbalance: Tone Test, Sensitivity Analysis, and the Universal Software Radio Peripheral," Submitted to IEEE Transactions on Instrumentation and Measurement, December 2008.

¹ It was observed in [4] that some imperfections are attributed to the software, but our main focus is the URSP2.