The 4th Workshop of COST Action IC0902
Cognitive Radio and Networking for Cooperative Coexistence of Heterogeneous Wireless Networks
October 9–11, 2013
Rome, Italy

AUTHORS CONSENT TO INCLUDE THIS CONTRIBUTION IN THE OPEN ACCESS ONLINE REPOSITORY OF IC0902: YES
NAME OF AUTHOR GIVING CONSENT: FERRANTE
(*NOTE THAT CONSENT SHOULD BE SHARED BY ALL AUTHORS*)

Insert here "Contribution to Working Group/Special Interest Group"
WG1: Definition of cognitive algorithms for adaptation and configuration of a single link according to the status of external environment

Insert title of contribution here
Experimental Acquisition of UWB Channel Impulse Responses

Insert authors and affiliations here
Ferrante G. C. (Sapienza U., Supélec),
Elhillali Y. (Univ. Valenciennes),
Di Benedetto M.-G. (Sapienza U.),
Boukour F. (IFSTTAR-INRETS),
Atika R. (Univ- Valenciennes)

Insert name of presenter with affiliation here

Insert your text from here on (please 2 pages at maximum)

I. Introduction

In this report we present recent experimental activities on UWB indoor channel modeling carried out during the first week of July, 2013, in facilities of the University of Valenciennes and University of Lille, France. The report is structured as follows: in Section II equipment used during the measurement campaings is listed in detail; in Section III it is described a measurement campaign aimed at collecting data for the evaluation of the UWB channel coherence time; in Section IV Time Reversal MISO channels are studied in two different environments: 1) indoor line-of-sight, and 2) anechoic chamber with reflectors.

II. Equipment

The experimental equipment was:

- waveform generator (DAC)
  - maximum sampling frequency: 10 GHz;
  - quantization: 8 bits;
  - amplitude: 1 vpp;
- receiver (ADC)
  - maximum sampling frequency: 20 GHz;
  - quantization: 8 bits;
- antennas
  - 2 directive antennas (25 degrees);
  - frequency range: 0.7 – 18 GHz;
  - antenna factor: 22 to 44 dB;
  - gain (dBi): 1.4 – 15 dBi;
  - 1 antenna omni;
- preamplifier
  - frequency range: 9 kHz – 4 GHz;

- amplification: 20 – 30 dB.

III. Campaign 1: Coherence time

Novelty. No measurements are available above 1.5 GHz [1].

Goal. Sound the channel with pulses with bandwidths 0 ≤W ≤ 3 GHz.

Measurement description. The setup was as follows: a single transmit antenna (directive) sent a signal with given bandwidth to a single receive antenna (omni); the distance between antennas is 4.2 meters. The same signal was sent with a repetition time of 400 ns. The receiver samples the continuous-time signal at 10 GHz and the amplitude of each sample was quantized with 6 bits check sampling and quantization parameters; 500 realizations of the sampled and quantized signal were averaged and saved. This procedure was repeated 200 times with an interval of 5 seconds. An example of impulse response at two times is shown in Fig. 1.

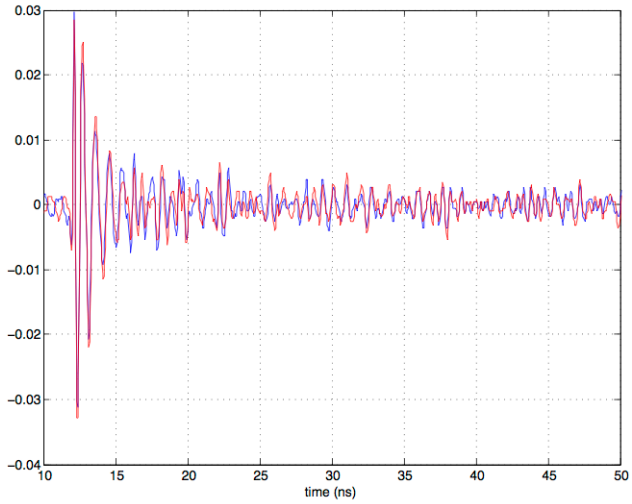

FIG. 1: Waveforms received with time difference of 200 seconds in our overnight campaign.

IV. Campaign 2: MISO UWB channel impulse response

Performance of MISO systems with All-Rake receiver and without pre-filtering are dependent on correlation between channels; however, recently we pointed out [2] that a MISO system with Time Reversal and one-finger Rake is insensitive to lack of correlation between channels in terms of SNR, which promise an SNR gain equal to the number of transmit antennas.

Novelty. No experimental results on this topic are available.

Goal. Verify that the gain offered by time reversal is equal to the number of antennas even if channels between transmit antennas and receive antenna are uncorrelated.

Measurement description. This campaign was repeated in two different environments: 1) indoor line-of-sight, and 2) anechoic chamber with reflectors.

In the first case, two directive antennas were located at 4.2 m from the receive antenna. The signal sent was the monocycle shown in Fig. 2, sampled at 20 GHz. Measures with different distances between transmit antennas were repeated, precisely with 0.24 m, 0.30 m, 0.35 m, 0.80 m, and 1.10 m. Channel estimation was performed by averaging 500 times the signal received by each transmit antenna, used one at a time during the estimation phase. Fig. 3 compares received waveforms with and without time reversal.

In the second case, similar measures in the anechoic chamber were repeated. In order to produce a multipath channel, metallic reflectors were placed within the chamber and transmit antennas were tilted from the line-

of-sight; an artificial multipath channel was therefore generated, and received waveforms with and without time reversal were recorded.

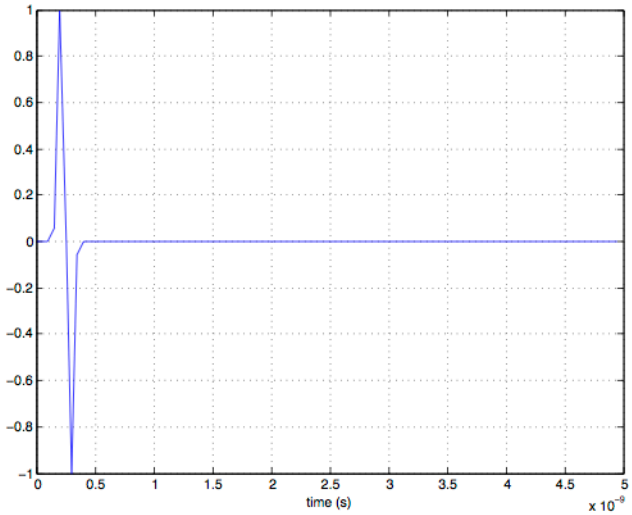

FIG. 2: Transmitted monocycle (first order derivative of Gaussian waveform).

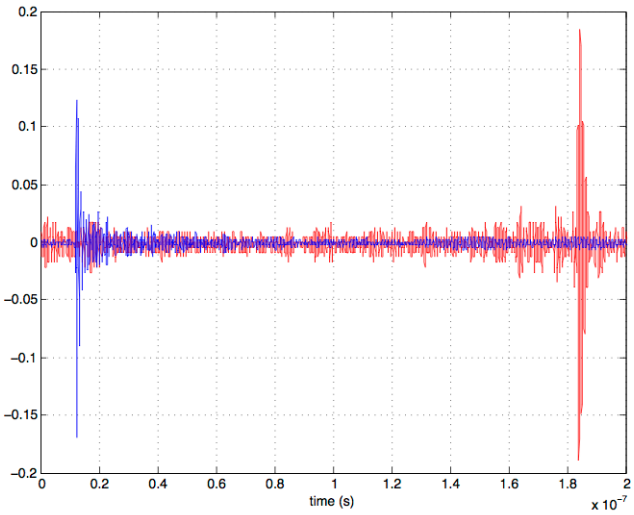

FIG. 3: Comparison between the waveform received without (peak on the left) and with (peak on the right) Time Reversal. Distance between transmit antennas: 0.24 m.

V. Conclusions

In this work, we report on experimental activities aimed at collecting data useful for UWB channel modeling and validation of theoretical argument recently developed. Channel impulse responses with one and two transmit antennas and one receive antenna were collected transmitting pulses with several bandwidths and in different environments. Collected data will be useful for upcoming investigations on specific properties of channels, such as sparsity and diversity order of channels vs. bandwidths, and also in order to extend known results to higher bandwidths.

References

[1] Qiu R., Zhou C., Guo N., Zhang J. Q., "Time Reversal With MISO for Ultra-wideband Communications: Experimental Results," IEEE Antennas and Wireless Propagation Letters, vol. 5, pp. 269-273, 2006.

[2] Ferrante G. C., Fiorina J., Di Benedetto M.-G., "Time Reversal Beamforming in MISO-UWB," IEEE ICUWB 2013, accepted.