Seminar on

Multiplexing Device for Microwave Imaging

by

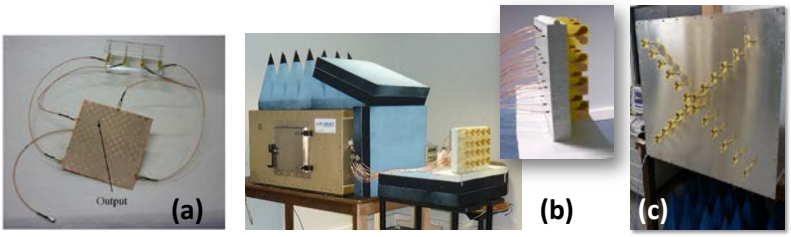
Prof Cyril Decroze

XLIM Laboratory

Date : 07 October 2015 (Wednesday)
Time : 04:00 pm – 05:00 pm
Venue : Room 15-202, 15/F, meeting room of State Key Laboratory of Millimeter Waves, 15/F, Academic 3, City University of Hong Kong

Abstract

Electromagnetic waves backscattered on a scene can be collected to perform imaging in different ways. The most common approach is to capture several waveforms on regularly spaced antennas and combine them with the appropriate weights to achieve a steering of the reception beam. The waveforms weighting can be applied physically using phase shifters and amplifiers but these active devices are always limited by the signal bandwidth. The weighting can also be computed in baseband post-processing assuming that the system is composed with as many reception chains as antennas to capture all the waveforms at the same time, increasing the cost and the complexity of the system. Finally, by using moving parts, a virtual array can be created to achieve synthetic aperture radar imaging. To improve acquisition time, XLIM laboratory has developed passive time reversal beamfomers devices to reduce the complexity of classical systems. Those devices are able to address simultaneously and independently each radiating element of a multi-antenna system. Used in reception, they constitute a passive multiplexer for encoding signals received by an antenna array to a common output through orthogonal channels. The incoming signals on each antenna can be retrieved from the received waveform by deconvolution techniques. Thus, numerical beamforming or conventional near-field imaging are calculated in post-processing. The first feasibility studies of this original principle were performed in 2012, using a chaotic reverberant cell as a beamformer component. It has been proved that it is possible to focus signals independently on the device outputs, depending on the signal waveform at the only input and using time reversal techniques. The results showed the feasibility to realize a passive beam scanning UWB radar [1]. The 3D imaging capability of this technique was presented in [2], using a single port MIMO multiplexer. Thereafter, miniaturization techniques have been developed, using frequency selective planar structures [3][4], or orthogonal frequency coding device based on surface acoustic wave (SAW) filters [5]. Such a component has been used to set up real time demonstrator, able to track a moving target [4].



Passive FSS demultiplexer for numeric beamforming radar (a), Passive UWB Multiplexing device for a Single-Port near field MIMO RADAR (b), MIMO Multiplexer for microwave imaging (c)

[1] Fromenteze, T.; CARSENAT, D.; DECROZE, C., "A Precorrection Method for Passive UWB Time-Reversal Beamformer," *Antennas and Wireless Propagation Letters, IEEE* , vol.12, no., pp.836,840, 2013

[2] Fromenteze, T.; DECROZE, C.; CARSENAT, D., "Passive UWB multiplexing device for a single-port MIMO RADAR," *Microwave Symposium (IMS), 2014 IEEE MTT-S International* , vol., no., pp.1,4, 1-6 June 2014

[3] Fromenteze, Thomas; Decroze, Cyril; Carsenat, David, "Miniaturized device for passive microwave UWB beamforming," *Antennas and Propagation (EuCAP), 2014 8th European Conference on* , vol., no., pp.354,358, 6-11 April 2014

[4] T. Fromenteze, C. Decroze and D. Carsenat, “Waveform coding for passive microwave imaging”, IEEE Transaction on Antennas & Propagation, under review.

[5] Fromenteze, T.; DECROZE, C.; CARSENAT, D.; Crunteanu, A; Chatras, M.; Passerieux, D., "Passive Beamforming Using Surface Acoustic Wave Filters," *Antennas and Wireless Propagation Letters, IEEE* , accepted, august 2014

Biography

Cyril Decroze was born on 19 June 1975. He received the Ph.D. degree in telecommunications engineering from the University of Limoges, Limoges, France, in 2002. He is currently an Associate Professor in the XLIM Laboratory, and obtained the accreditation to direct research (HDR) in December 2013. Since 2006, he has been in charge of the wireless systems team in the Wave & Associated System Department at XLIM. His field of research concerns multiple antennas transmission systems, and associated processing for communications and radar, as well as channel sounding and channel emulation (multipath channel emulation in Reverberation Chamber for MIMO terminals qualification, real time Air-Ground-Air channel emulation for a aeronautic devices testing, …). His activities are supported by a strong experimental part, including test-benches development, allowing active characterization of antennas processing algorithms: MIMO coding, numeric beamforming, radar imaging, time reversal compressive beamformers, antenna measurements in non-anechoic environments, ...). He participated in 3 national research funding (ANR) projects (including one as scientific leader), 3 European projects (including 2 as a scientific leader), 5 regional projects (including three as scientific leader) and 6 industrial contracts. He co-supervised 11 PHD theses (3 ongoing). He has also authored, coauthored 21 publications in international journals, 40 international communications, 4 patents (including 2 pending).

***** ALL ARE WELCOME *****

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