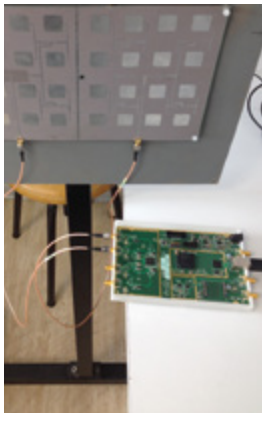
Bio-Radar – Measuring the Breath rate without physical contact

Carolina Gouveia[1], José Vieira[1], Pedro Pinho[2], Daniel Malafaia[3]

1 — Department of Eletronics, Telecommunication and Informatics, University of Aveiro
2 — Instituto Superior de Engenharia de Lisboa and Instituto de Telecomunicações, Instituto de Telecomunicações
3 — Instituto de Telecomunicações

The Bio-Radar is a system capable of monitoring vital parameters, such as respiratory and cardiac rhythms, without requiring any kind of contact with the human body, i.e. without the use of electrodes. This wireless monitoring system has several applications that aim to improve the quality of life in everyday situations, such as the continuous monitoring of bedridden patients, for example in hospital burn units where direct contact with patients is not recommended, sleeping monitoring for Obstructive Sleep Apnea Syndrome patients or even for rescuing people from collapsed buildings.

A Bio-Radar prototype was developed in the Telecommunications Institute and it can measure the respiration rate at more than 2 meters. This system uses the Doppler effect principle that relates the received signal properties with the distance change between the radar antennas and the person's chest-wall. It is composed by a continuous wave radar, that generates digitally a sinusoidal signal, modulates it in phase and quadrature with a carrier equal to 5,8 GHz and then transmits it towards the target, which is the patient's chest. The received signal will be a phased modulate version of the transmitted signal which occurs due to the chest-wall motion while the patient is breathing. This motion changes the travelled distance of the electromagnetic waves causing the phase modulation.



The prototype was developed with focus in real-time acquisition and processing of the respiratory signal. It is composed by a front-end based in Software Defined Radio and two antennas for transmission and reception, respectively. Then, the acquired signals are processed using the LabVIEW software from National Instruments, where an algorithm is implemented with the purpose to extract the vital signals accurately.

The overall system's performance was evaluated using as reference a certified measuring equipment, the BioPac MP100. The respiratory signal was measured using both acquisition systems, the Bio-Radar and the BioPac, simultaneously and the results were very accurate.

The prototype was developed with focus in real-time acquisition and processing of the respiratory signal. It is composed by a front-end based in Software Defined Radio and two antennas for transmission and reception, respectively. Then, the acquired signals are processed using the LabVIEW software from National Instruments, where an algorithm is implemented with the purpose to extract the vital signals accurately. The overall system's performance was evaluated using as reference a certified measuring equipment, the BioPac MP100. The respiratory signal was measured using both acquisition systems, the Bio-Radar and the BioPac, simultaneously and the results were very accurate.