

NOVA I4H – Thesis Proposal

Title:

Milimeter wave radar for remote biosignals and human movement monitoring.

Objectives:

The collection of vital signals has been done with intrusive techniques that require a physical interaction with body to collect electrical or mechanical signals. A novel approach for of the body sensing has appeared with near touching devices based on capacity sensing of vibration propagation. These techniques enable flexibility and facilitates the use of the interaction of the subject on study.

With the advent of autonomous vehicles several types of radar technologies have been developed for the external and internal of the vehicles, creates an opportunity to explore these new technologies on vital signals and human movement analysis.

The usage of radar enables the measure of distance based on the delays and phase of the reception of a known emitted wave. These techniques already have proof of concepts on biosignals measurements [1,2,3] where waves with a frequency range from 450MHz up to 10GHz have been used to detect heart beats and respiration phenomena. Using the previous example, a car could be designed to have the driver continuously monitored at a distance even in the case of the autonomous driving to be able to request the attention of the driver when needed.

The main goal of this thesis is to review the state of the art on radar monitoring, evaluate the different technologies and develop novel approaches for vital sensing and human movement. The student should develop a novel working monitoring mechanism based on radar technology and evaluate the, stability, signal quality, safety. The capability of visualizing the extracted signals from the radar will also be covered to be able to use the information for human movement analysis.

Framework:

Established in 2007, PLUX creates innovative products for industry, clinicians and researchers, by developing advanced biosignals monitoring platforms that integrates wearable body sensors combined with wireless connectivity, algorithms and software applications. PLUX has a strong background on research collaboration with Universidade Nova de Lisboa. In the context of this thesis, the research on novel algorithms for fNIRS analysis will enable the extraction of useful knowledge about the human brain and its application to psychology, sports and medicine.

This project will be developed in collaboration with the laboratory of Biomedical Instrumentation Lab – LIBPhys of Universidade Nova de Lisboa and will be supported by a company/faculty PhD grant assigned by FCT.

Tasks:

The candidate should investigate the current state of the art on radar types and the applications to the biomedical area. The student should be proficient on biosignals analysis and electronics development to integrate and extract information from off the self mmwave radar toolkits. The intermediate results of the PhD should be presented in conferences and published in journals with known impact factor, on the areas of biomedical engineering and machine learning. During the innovation process, careful attention should be given to identify ideas that can be part of intellectual property protection.

Venue:

This project will take place in the Biomedical Instrumentation Lab of FCT/UNL, as well as in PLUX Wireless Biosignals.

Candidate profile:

Considering that this project focuses heavily in electronics and signal processing, the candidate should have expertise on biomedical engineering, electrical engineering or physics engineering. The candidate should have experience in implementing analog/digital signal processing algorithms.

The capacity to innovate, and develop new techniques for sensing systems along with the physical design devices, as well as the necessary critical aptitude towards all the procedures that he/she might be involved.

In addition, since this collaboration is between a faculty and an enterprise, the candidate must be prepared to develop his/her activity in an industrial environment, when necessary.

Supervisor

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