Radar based gait analysis for the elderly  
---gait pattern recognition based on machine learning

The past century has seen remarkable improvements in life expectancy due to improvements in public health. The consequence of the increased life expectancy is an increasing aging population. According to WTO, the proportion of the world's population over 60 years will double from about 11% to 22% between 2000 and 2050. The absolute number of people aged 60 years and over is expected to increase from 605 million to 2 billion over the same period. Of Sweden's 10 million inhabitants, 20 % have passed the standard retirement age of 65 and this number is projected to rise to 23% by 2040.

Typically, the 'normal aging' process entails alterations in sensory, motor, and cognitive functions that have been linked to poor quality of life, functional decline, increased risks of falls and impaired mobility. Additionally, disease related motor impairments, including gait disorders and slowing of movements, are increasingly common with advancing age.

It has long been known that there is a direct relationship between cognitive impairment severity and increased gait abnormalities. Early motor dysfunction co-exists with or even precedes the onset of cognitive decline in older adults. For example, gait patterns tend to differ from its normal behavior at the early onset of some neurodegenerative diseases, such as Alzheimer’s and Parkinson’s. A person at the primary phase of Parkinson’s tends to make small and shuffled steps and may also experience difficulties in performing key walking events, such as starting, stopping, and turning. Short shuffling steps with difficulty lifting the feet off the ground were reported to be associated with increased risk of developing dementia. However, these early changes in gait may be too subtle to be detected by untrained eyes. Constant measurement and quantitative assessment of gait patterns is needed in order to detect the changes that indicate decreasing cognitive functions and enable early diagnosis of neurodegenerative diseases.

We propose to combine radar technology and machine learning for continuous gait monitoring & analysis in order to detect small diseases-correlated gait changes in time, enabling early prediction and prevention of diseases. Radar technology is the most suitable candidate for health monitoring at home due to its safety, simplicity, cheapness, being non-contact and unobtrusive, while preserving privacy.

![Figure 1 The millimetre wave radar sensor](image)

As a first step, in this master thesis project we will work on radar-based gait pattern recognition based on machine learning. The aim is to get a good understanding of key gait features as well as the potential & limitation of machine learning in this research problem.
More specifically, you will perform the following work in this project:
1) Perform gait measurement on different subjects* with a radar sensor (Figure 1).
2) Choose a suitable machine learning model and train the model with collected data
3) Evaluate the developed algorithm and improve the model
(* the measured subject can be yourself, your friends and (or) recruited volunteers.)

Prerequisite:
Master students in biomedical engineering (MPBME), computer science, wireless, photonics and space engineering (MPWPS) or other electrical engineering and engineering physics programs. Good knowledge and experience in signal processing is a merit.

Project length: one year

Number of students: two

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