Extracting Breathing Patterns in 3D Radar Sensor Data

Background
With an aging global population and an increase in chronic health conditions such as diabetes, cardiovascular diseases, and sleep disorders, there is a critical need for improved health monitoring systems. Traditional methods, such as wearables and manual monitoring, often fall short due to their invasive nature and inability to provide continuous, accurate data. Radar sensor technology offers a non-contact solution for continuous assessment of vital signs, but current applications are limited and typically require fixed positioning close to the monitored individual. This limits their practicality for long-term care settings. The project aims to leverage radar sensor data, combined with advanced AI techniques, to develop a robust health monitoring system that can accurately detect breathing patterns, despite the challenges posed by body movements.

Aim
To develop method that accurately detects breathing patterns during sleep in radar data.

Materials and Methods
The project will utilize radar sensor data, specifically time-series data of 3D point clouds and range-Doppler maps, to analyze body and micro-movements. Initial data preprocessing will involve normalizing and filtering. Subsequently a model will be developed to extract breathing rate using algorithms based on Fourier transform, wavelet transform, and artificial intelligence. The model will be validated against wearable monitoring methods using data from a clinical study involving 40 participants, encompassing over 480 nights of sensor data.

Nature of the Thesis:
- Literature research: 10%
- Data and image processing and programming: 80%
- Documentation: 10%

Requirements:
- Motivation to work in a multidisciplinary team
- Programming skills in python for data processing and AI
- Familiarity with movement science is a plus

Fig. Patient with overlaid point cloud and the radar sensor [1].

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