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Uncertainty quantification for machine learning models applied to photoplethysmography signals

22HLT01 QUMPHY

Project Aims

- Investigate performance of machine learning algorithms for photoplethysmography (PPG) signals that could be used for **diagnosis of diseases** (elevated blood pressure, diabetes, atrial fibrillation) or **continuous health monitoring**
- Increase trust in diagnostic predictions by defining **uncertainty quantification measures** to assess machine learning algorithms
- Compile standard **benchmark datasets** to compare machine learning methods and uncertainty measures
- Improve reproducibility and reliability of machine learning with open **software repository** and **guide on uncertainty quantification**
- Encourage **feedback and uptake** of benchmarks and testing framework by medical device, digital and healthcare communities

Wearable devices that collect PPG signals are:
- Noninvasive
- Easy to use
- Cheap
- Used in a clinical setting
- Widely available in smartwatches

Pulse oximeters are commonly used in hospitals

Smart watches are used daily by millions of people

WP1 Uncertainty Quantification

- Develop uncertainty quantification method for machine learning algorithms
- Apply these methods to 3 classification and 3 regression tasks involving PPG signals
- Determine which models have high accuracy and low uncertainty
- Investigate the effect of skin tone on machine learning predictions

WP2 Data and Promotion

- Generate 5 benchmark problems and make them publicly available
- Publish a good practice guide describing machine learning algorithms, uncertainty quantification methods and benchmark results
- Engage with the medical device, digital health and healthcare communities to promote uptake

WP3 - Impact

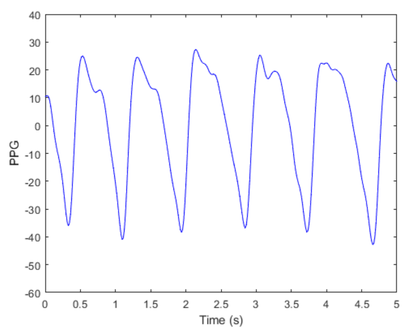
- Disseminate results to target communities
- Seek advice from Stakeholder Committee
- Present results at international conferences
- Disseminate results to standards bodies

PPG signals can be used for:
- Continuous monitoring
- Remote monitoring
- Diagnosis of disease
- Health alerts

Uncertainty quantification:
- Provides an indication of the confidence in the machine learning prediction
- Helps to establish trust in the machine learning results

Target Groups

- Healthcare communities (Arrhythmia Alliance)
- Digital healthcare companies (Vastmindz, Teltonika Telemedic)
- Clinicians and hospitals (NHS, Heidelberg)
- Metrological and scientific communities (U Marburg, TU Prague)



“It is critical for clinical decision-making to be able to understand the level of confidence that we can have in pulse oximeter measurements”

Timothy Bonnici, Consultant Critical Care Physician

“The application of machine learning to PPG signals could help rapidly scale up the use of virtual wards, reduce the burden on clinicians, and improve patient care at home”

Craig Shenton, Senior Data Engineer

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The Consortium has 16 Partners:

- **6 National Measurement Institutes**
- **7 Universities**
- **2 Companies**
- **1 Clinician**

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