

Knowledge-driven representation of biomedical signals for wearable device applications

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Motivation & Introduction

- Emerging use of wearable devices
- Large collections of connected devices
- Large amounts of data
- Limited presence of human experts
- Need for interpretability
 - poses challenge for traditional machine learning techniques



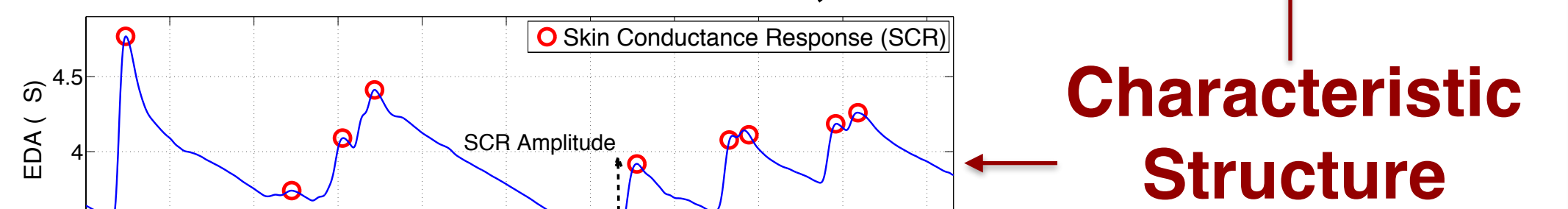
Data

Electrodermal Activity (EDA)

- Changes in skin resistance causing sweat
- Sympathetic activity (e.g. stress)
- Autism, epilepsy, sleep disorders

Electrocardiogram (ECG)

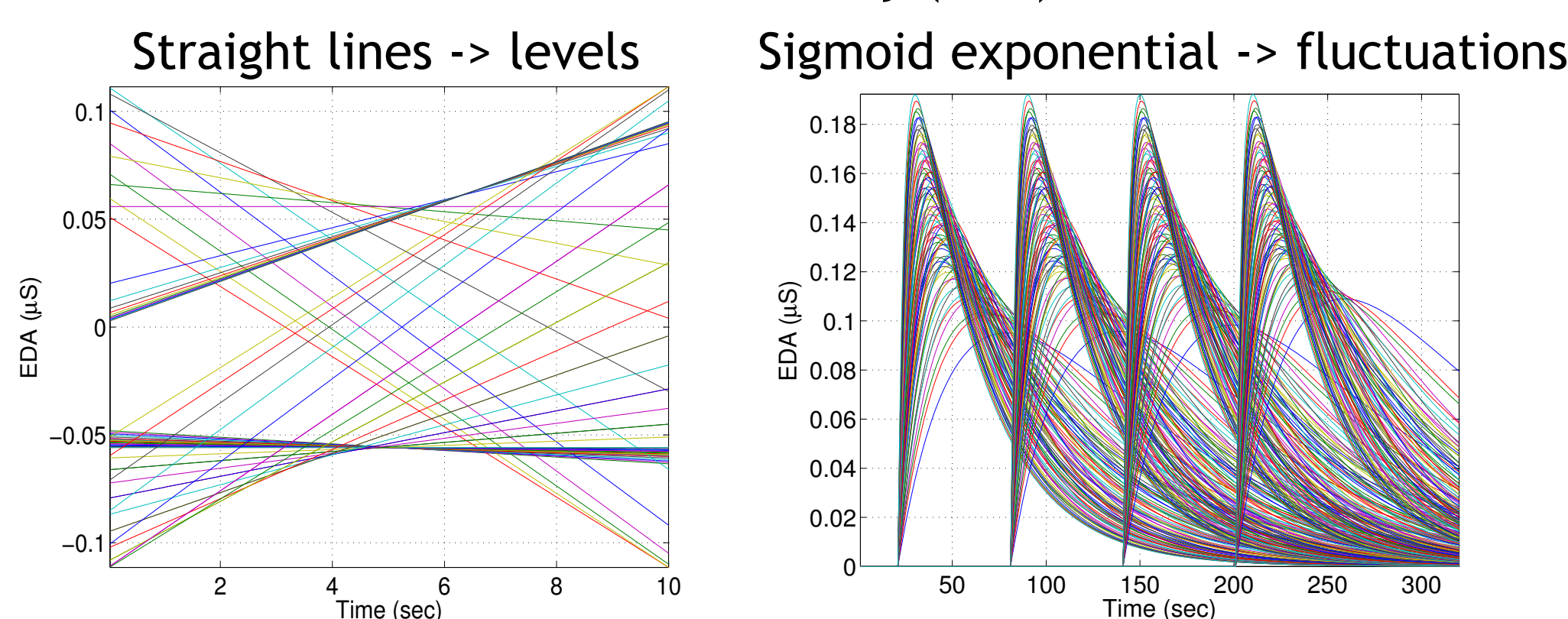
- Heart's electrical activity
- Sympathetic and parasympathetic
- Cardiovascular diseases, diabetes



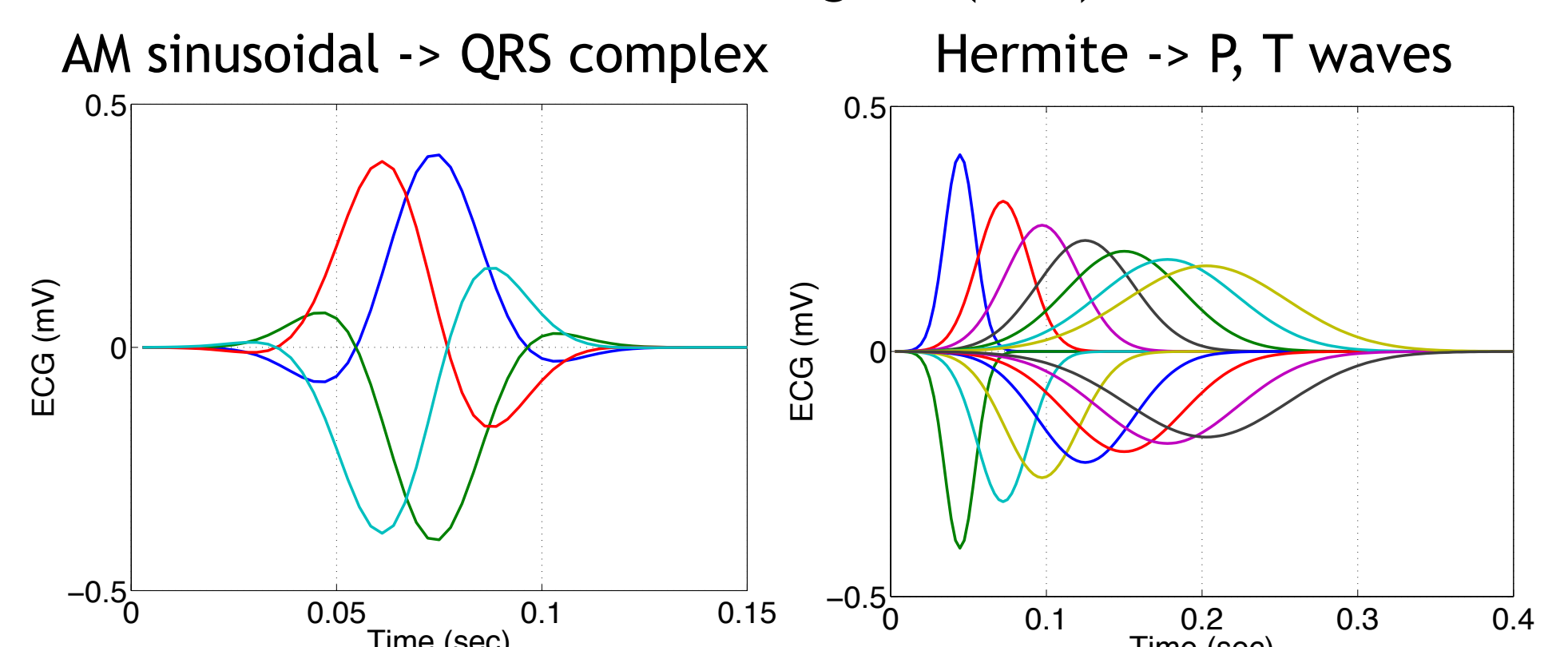
Knowledge-driven physiological representations

- Sparse representation (e.g. orthogonal matching pursuit) -> low-dimensional models
- Knowledge-driven parametric dictionaries -> interpretability
- Post-processing of selected dictionary atoms -> meaningful constructs (e.g. QRS complex, SCR)

Electrodermal Activity (EDA)

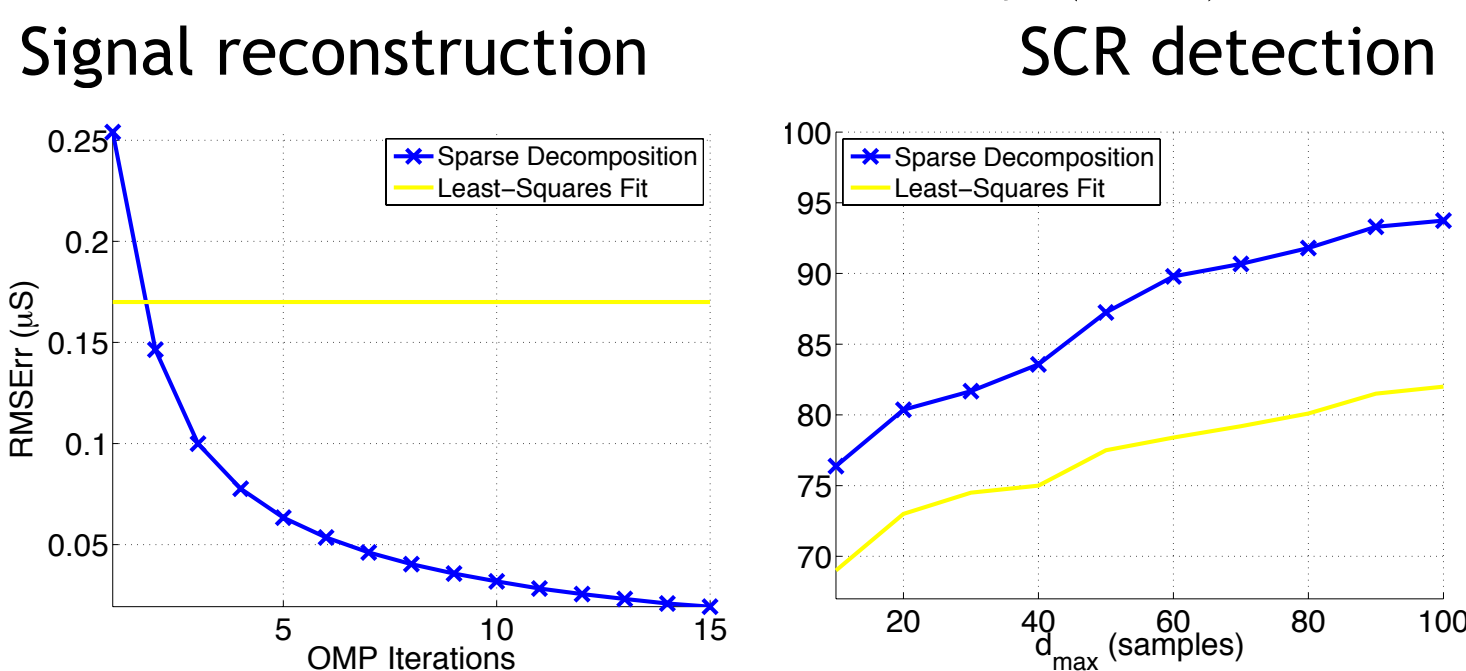


Electrocardiogram (ECG)

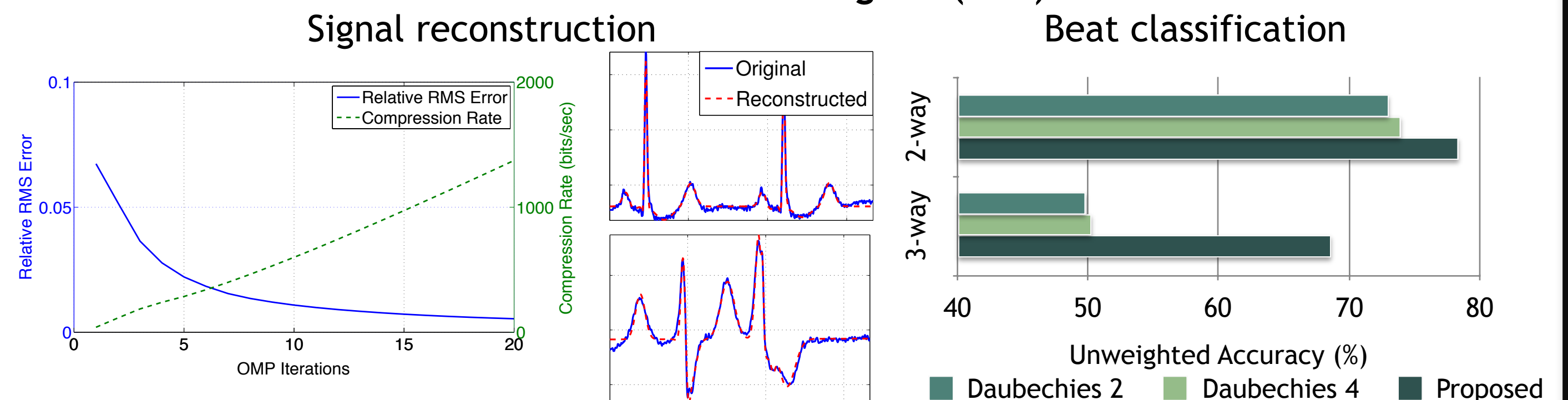


Results

Electrodermal Activity (EDA)



Electrocardiogram (ECG)



Discussion & Future work

- Reliable signal representation
- Interpretation of selected atoms
- Capturing meaningful signal variations
- Combine data-driven approaches (e.g. DNNs)

References

- Chaspari et al., "Sparse representation of electrodermal activity with knowledge-driven dictionaries," IEEE TBME, 2015
- Chaspari et al., "Markov chain Monte-Carlo inference of parametric dictionaries for sparse bayesian approximations," IEEE TSP, 2015
- Balasubramanian et al., "A knowledge-driven framework for ECG representation and interpretation for wearable applications," submitted to ICASSP 2017