# Preterm infant heart rate variability feature selection for automated sleep state classification

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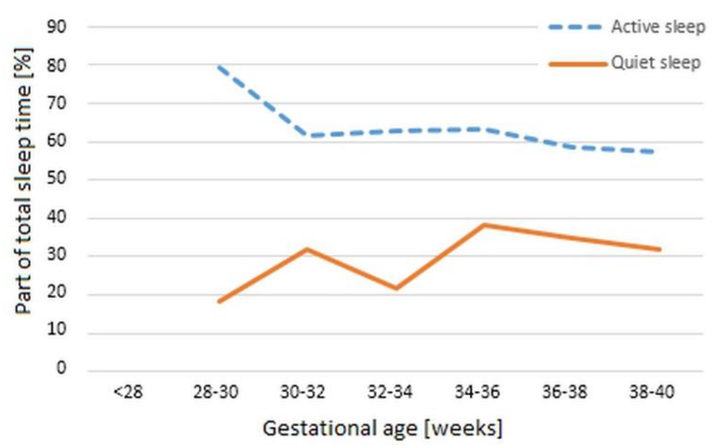
## Introduction

- Preterm infant sleep can be separated into different sleep states (mainly active, quiet and intermediate) and sleep-wake.
- The change of the sleep state duration over time is correlated with the neural development of the preterm infant.




*The sleep states active (AS) and quiet sleep (QS) over the gestational age in weeks in percent of the total sleep time. Mean values from collected publications on preterm infant sleep states.*

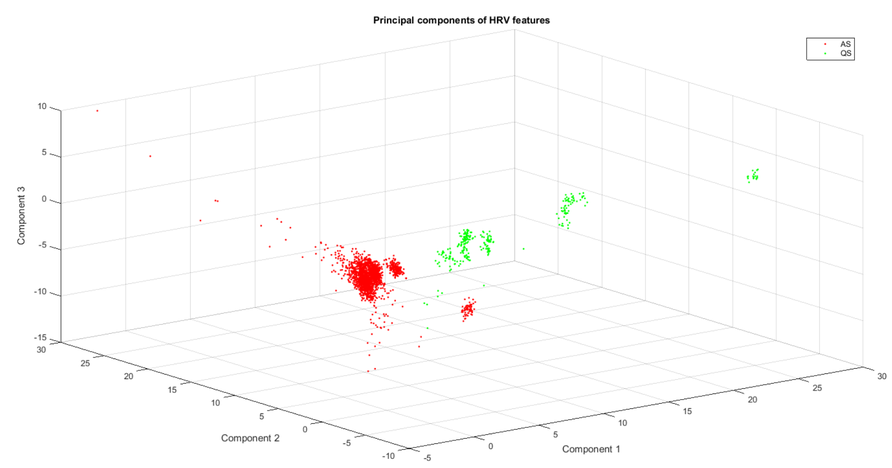
- The sleep state analysis can be used for development monitoring and the sleep wake identification for organizing the handling of the preterm infant around his sleep pattern.
- To date the sleep state analysis is done manually on the base of polysomnography analysis by neonatologist and/or sleep experts.
- **<u>An automated sleep state analysis will make continuous development monitoring possible</u>**

## Method

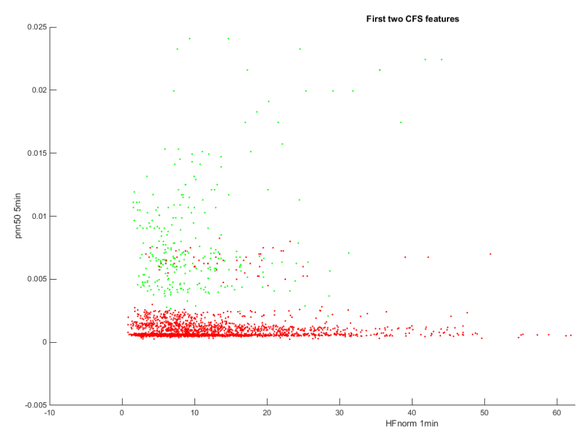
- The sleep states can be separated via vital sign and/or actigraphy analysis. We are focused on heart rate variability (HRV) analysis.
- We have a dataset with ECG recordings from 10 preterm infants with mean age of 32wk GA. The recording length varies between three and seven hours.
- The data was annotated by three trained annotators with an overall moderate interrater agreement (Mean $\kappa$: 0,46; SDV: 0,18).
- We use 51 HRV features which are adapted from adult sleep staging.

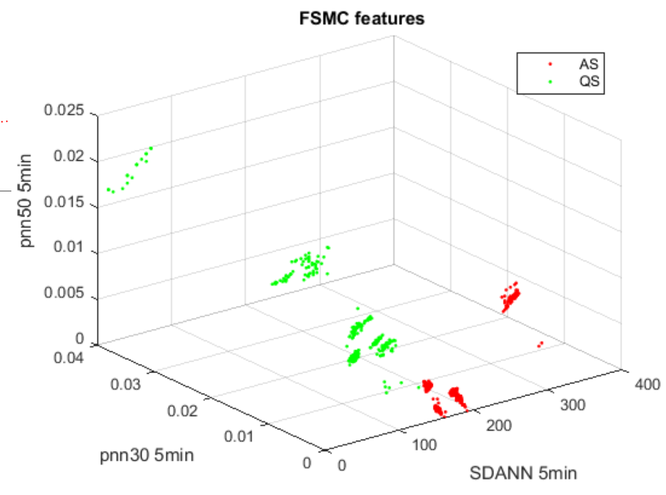
## Results

We analyzed our features with three feature selection methods: Principal component analysis (PCA), correlation based feature selection (CFS) and minority class feature selection (FSMC). CFS and FSMC resulted in similar top ranking features.




*Results of the PCA for two classes AS and QS. The results promise an effective use of linear classification.*




*The use of the top features resulting from the CFS and FSMC show positive results regarding the use of linear classification*

## Conclusion

- Linear classification of the preterm sleep states seems possible.
- Age and position do not play a determining factor for the classification. Additional information might increase the classification performance
- A larger dataset is needed to proof the stable classification of preterm infant sleep states.

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