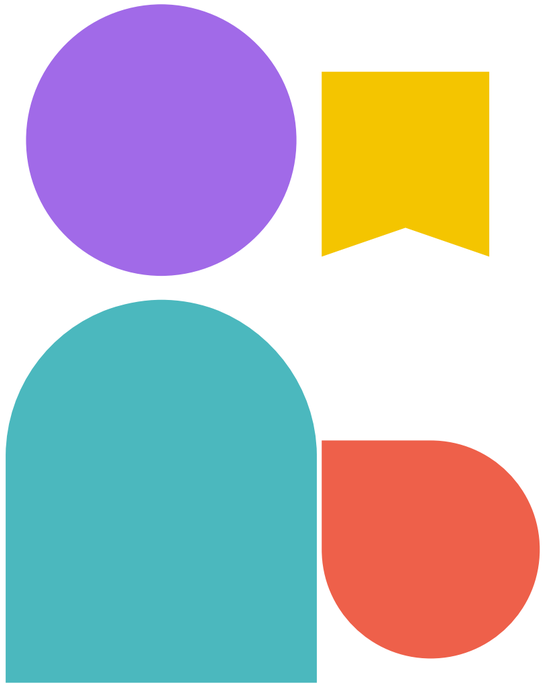
Comparing random forest classifiers and the HDCZA heuristic algorithm for sleep onset and wake detection



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The Problem

Sleep study and detection is difficult

Sleep diaries are cumbersome and often inaccurate

Wrist-worn accelerometers are a solution

Convenient and accurate, provided detection algorithm is sound

Use different methods and compare

Can provide insights into why a method might be better

Related Work

Conventional ML Models

- Bagging decision tree classifier - Boe *et al.*
- Random forest - Sundararajan *et al.*
- K-means clustering and HMMs - Subramanian *et al.*

Heuristic Approaches

- Automated sleep detection algorithm using R package (Change of Z-Angle) - Plekhanova *et al.*
- Detecting SPT window using the variance in z-axis angle without sleep diary - van Hees *et al.*

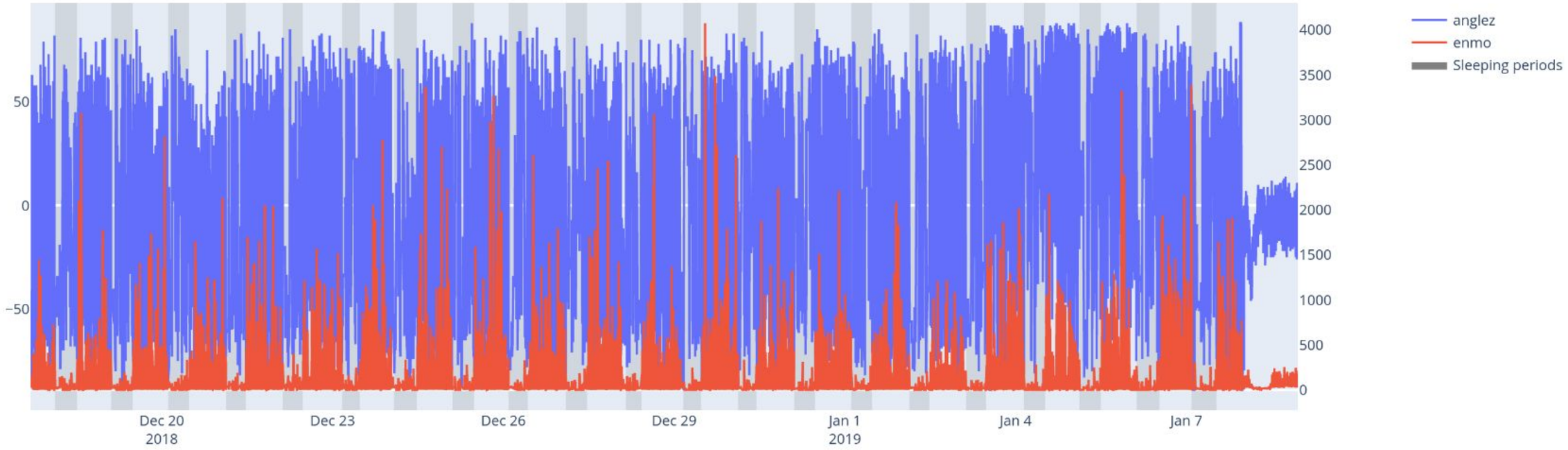
Which works best - Random forest classifier or HDCZA?

Let’s compare them and find out!

Data Exploration

About the data

Events (Onset/Wakeup) and time-series (5 second time-steps)



z-angle

Angle between arm and vertical axis of the body

ENMO

Summary measure of all accelerometer data

Random Forest classifier

Feature selection is important

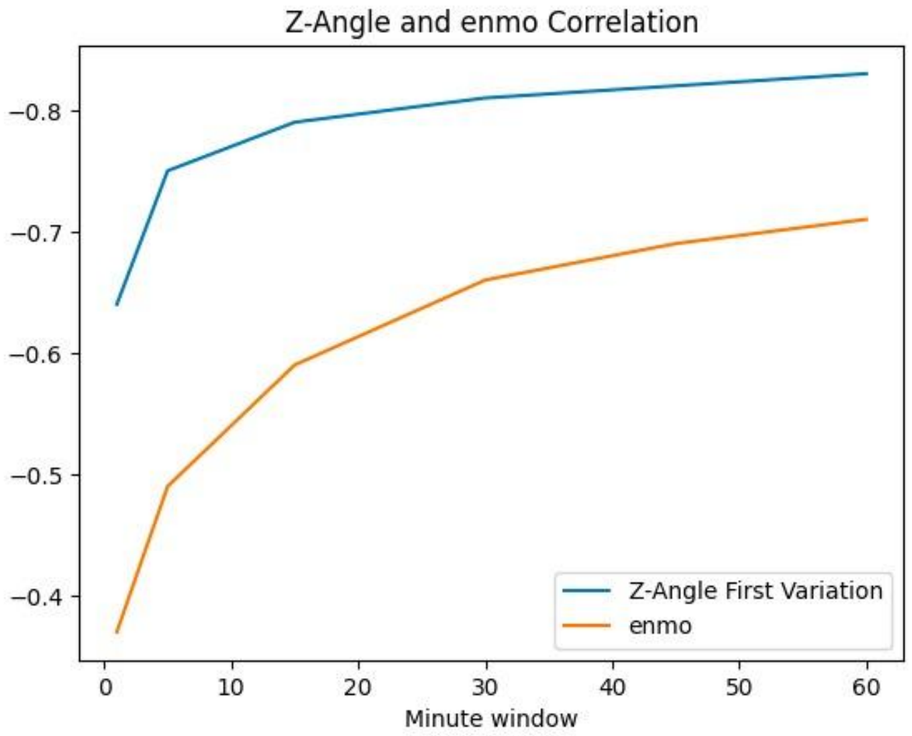
First variation of Z-angle and ENMO with various rolling windows

Compare correlation...

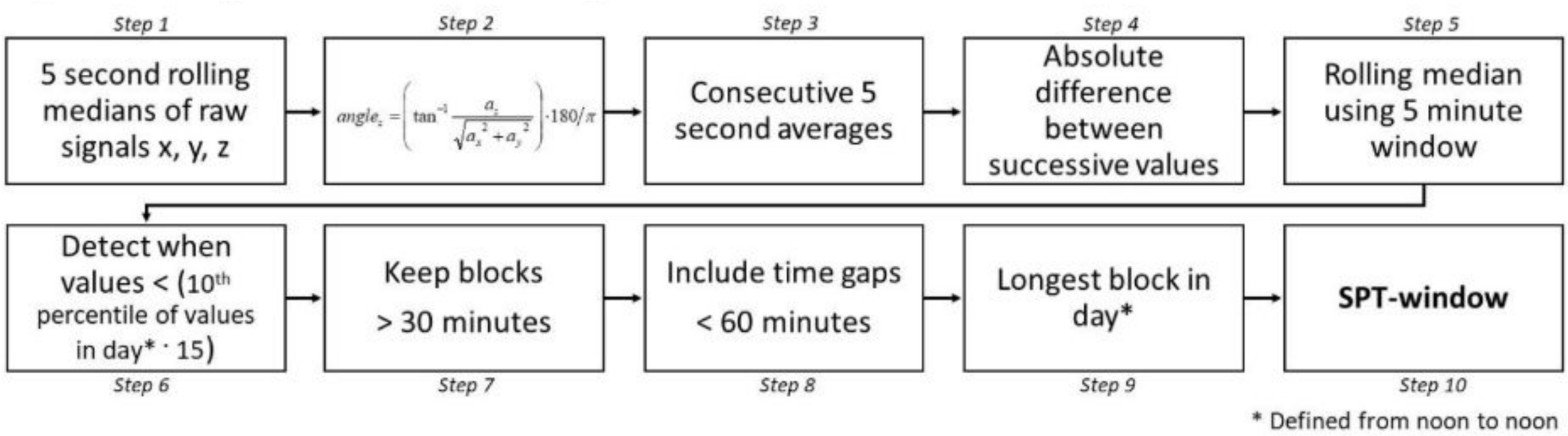
between sleep state and candidate features

Train RFC using the best features

Hyperparameter selection is also important



HDCZA Heuristic Algorithm



* Defined from noon to noon

Results & Conclusion

Test accuracy for RFC is

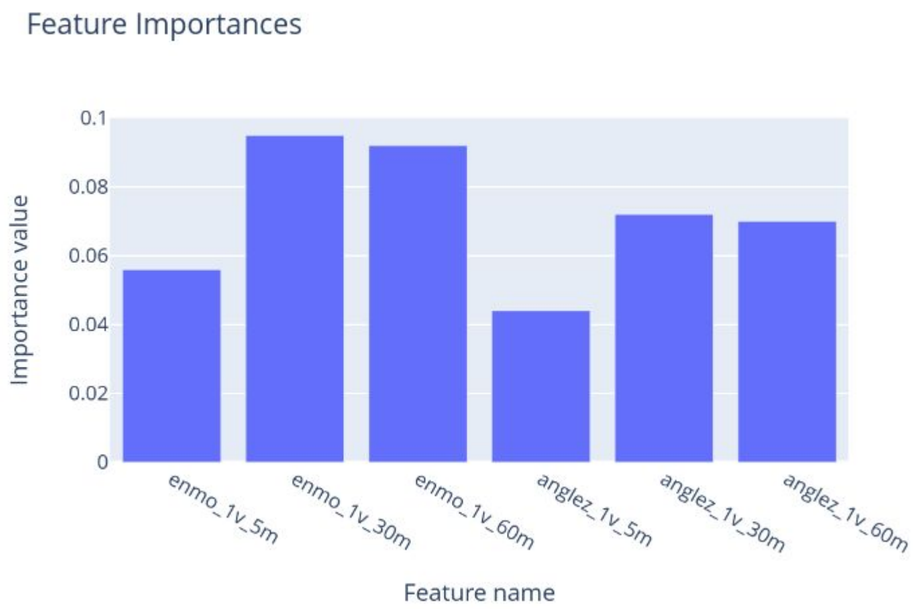
45.5%

Test accuracy for HDCZA is

30.4%

Verdict

RFC with feature selection works better than HDCZA



Future Work

Other features

- LIDS (Locomotor Inactivity During Sleep) calculated from ENMO
- Combination of Z-angle and ENMO

Deep learning approach

- CNNs could also be used to detect sleep windows

Thank you!