nano-tera.ch
swiss scientific initiative in health / security / environment systems

Universität Zürich[UZH]

Institute of Psychiatry and Neurology in Warsaw

FNSNF

Automatic artifact detection in long-term EEG recordings

A. Malafeev[1], A. Wierzbicka[2], A. Wichniak[2], P. Achermann[1]

1 University of Zurich, Institute of Pharmacology and Toxicology, Chronobiology and Sleep Research

2 Institute of Psychiatry and Neurology in Warsaw, Department of Clinical Neurophysiology, Sleep Disorders Center

WearMeSoC RTD 2013

Introduction

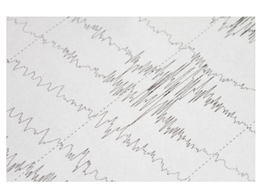
We are aiming to create algorithms for automatic detection of artifacts in long-term EEG recordings for further automatic analysis of the data. We are looking at EEG data recorded from narcoleptic patients during a Multiple Sleep Latency Test (MSLT). We aim to separate sleep and wakefulness phases, but first we need to detect artifacts in input signal.

Methods

Continuous, 9 hours long polysomnography recording with 5 nap opportunities: 6 EEG, 2 EMG, 2 EOG and 1 ECG channel

Feature: EEG power in the range 40-90 Hz

Unsupervised artifact detection: ***K-means (KM)*** and ***Hidden Markov Model (HMM)***, applied to power in 1-s moving window, and ***Autoregressive Model (AR)*** applied to entire data set.



Results

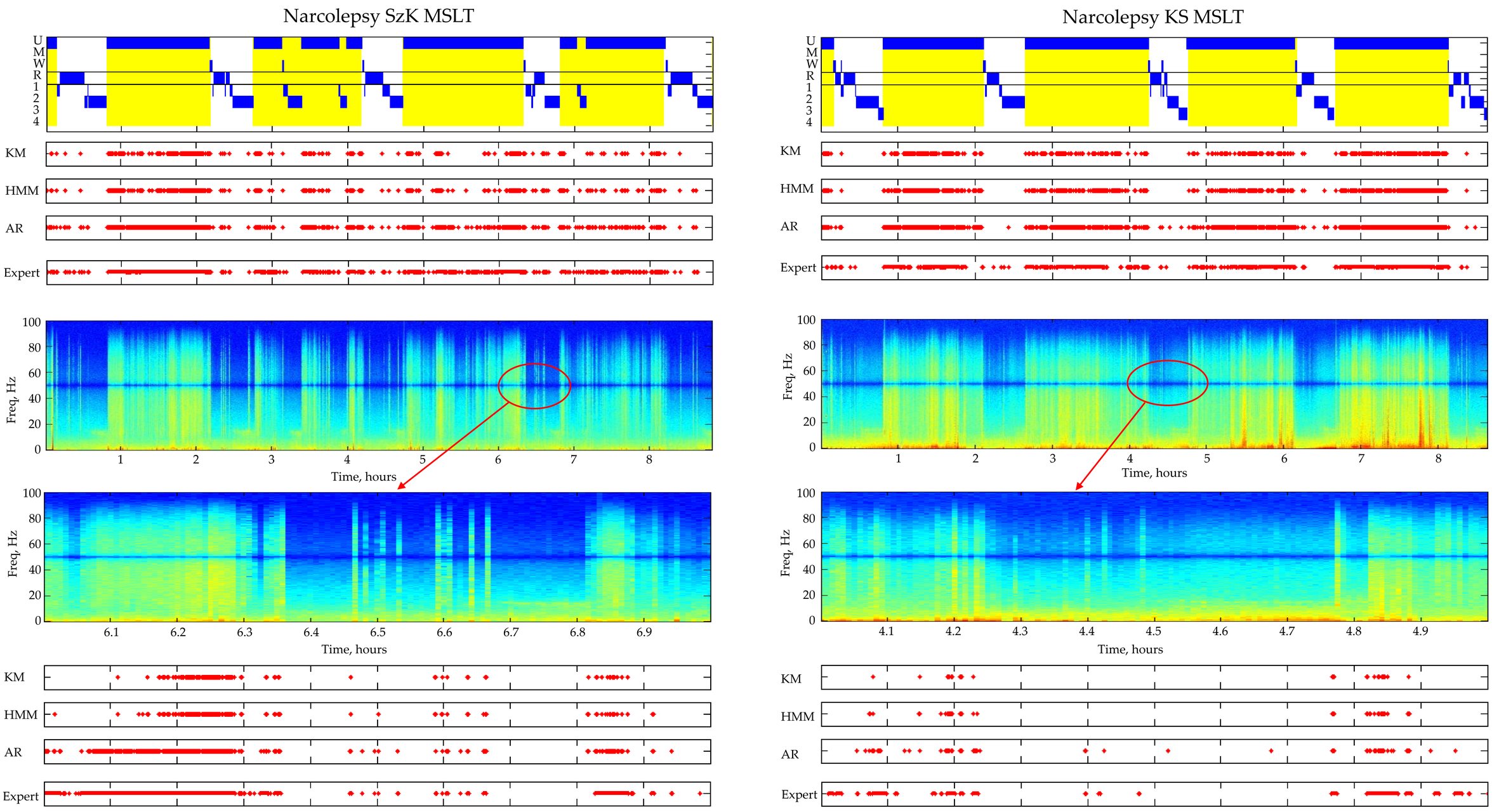
With all methods we could reliably identify long intervals of the EEG contaminated with artifacts. HMM and K-Means could not recognize short intervals of artifacts. In contrast, AR algorithm catched transient artifacts.

Narcolepsy SzK MSLT

	Sensitivity	Specificity
KM	0.58	0.88
HMM	0.70	0.83
AR	0.87	0.77

Narcolepsy KS MSLT

	Sensitivity	Specificity
KM	0.45	0.99
HMM	0.51	0.99
AR	0.82	0.97



Spectrograms and hypnograms are based on 30 second epochs, detected artifacts are marked with red dots

Conclusions

Using these algorithms we can identify severe artifacts (movement, electrode artifact, etc.). However, it is enough to exclude intervals with severe artifacts to make the signal suitable for automatic processing. We would like to develop better algorithms to catch also shorter artifacts.

AR method performs better than HMM and K-Means, and is also suitable for online analysis. In the future we aim to use more sophisticated AR approaches, i.e. adaptive or nonlinear models. We also aim to implement algorithms, which are able to distinguish between different types of artifacts.