RELATIONSHIP BETWEEN SLEEP STRUCTURE OF PATIENTS AFTER ISCHEMIC STROKE AND DAILY MEASURES

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STUDY OBJECTIVE

To identify specific sleep temporal profiles of patients in the acute phase of ischemic stroke, which are significantly correlated with different physiological, demographic or daily life measures.

SLEEP REPRESENTATION

- **sleep variables extracted from the AASM scores** [2]

tst	total sleep time	wtsp	wake within the total sleep period
eff	sleep efficiency	tst_stage	% of time spent in a sleep stage
sl	sleep latency	sl_rem	latency to REM

- **sleep probabilistic curves [3] for the sleep stages Wake, N1, N2, N3**
  - the REM stage added from the AASM scores

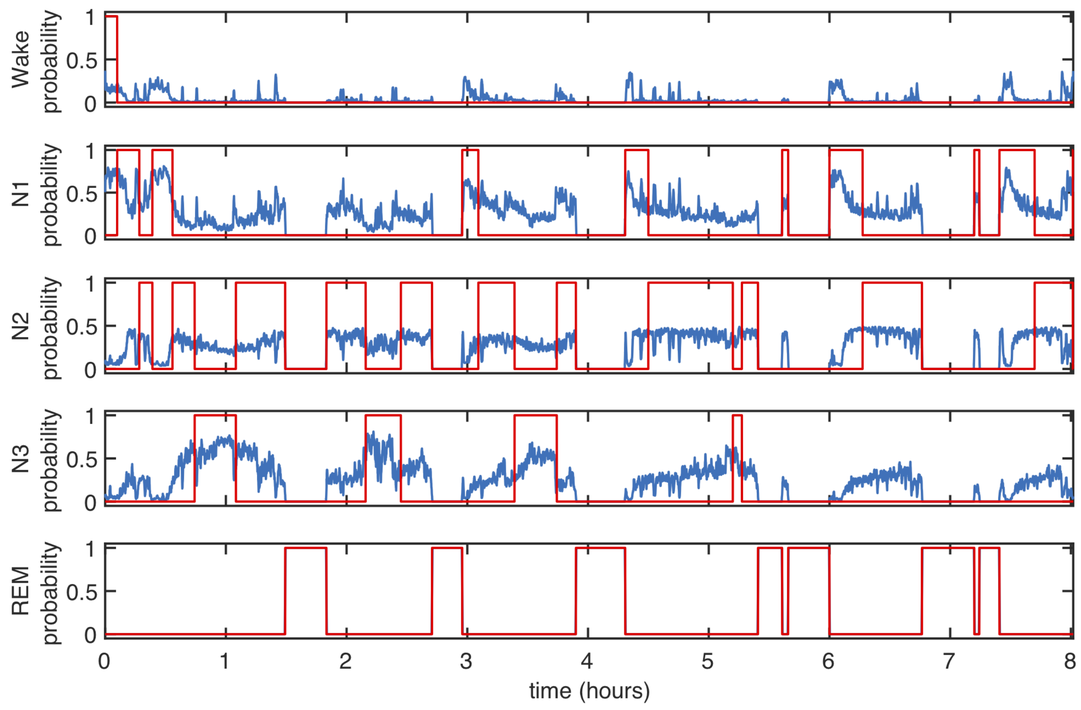


Figure 1: The sleep probabilistic curves (blue) and AASM scores (red) for a 60–year–old man.

METHODS

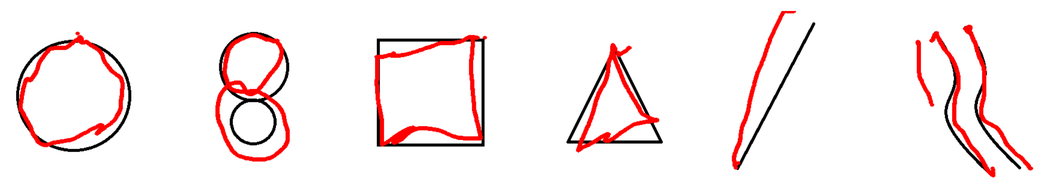
1. **"static approach"**
   - Spearman correlation coefficient between results of cognitive tests and sleep characteristics extracted from the AASM scores
2. **"dynamic approach"**
   - cluster analysis of the sleep probabilistic curves (k–means [4])
   - the Kruskal–Wallis test for detecting significant differences in cognitive tests between clusters

DATASET

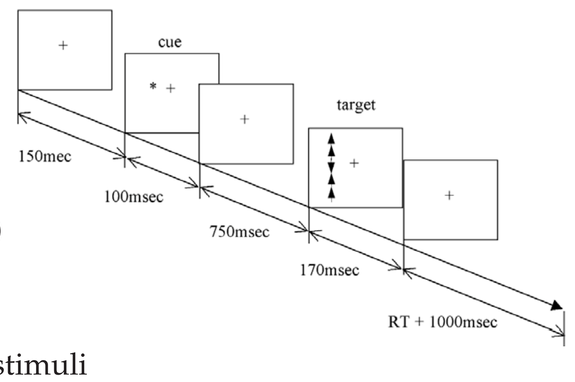
- **23 patients after ischemic stroke**
  - 6 women, 17 men; 57 ± 13 years; NIHSS $\in \{1, \ldots, 10\}$ [1]
  - hospitalised at the 1st Department of Neurology, University Hospital Bratislava, Slovakia
  - cognitive tests after the sleep EEG measurement (one to 10 days after stroke)

COGNITIVE TESTS

- **FINE MOTOR ACTIVITY TEST** (FMAT)
  - **goal:** to redraw the template patterns ⇒ percentage of correctly retraced pixels



- **LATERALISED ATTENTION NETWORK TEST** (LANT) [5]
  - **Alerting** (LANT_A)
    → benefit of temporal pre–cues
  - **Orienting inhibitory** (LANT_OI)
    → cost of an invalid spatial cue
  - **Orienting facilitatory** (LANT_OF)
    → benefit of a valid spatial cue
  - **Conflict resolution** (LANT_C)
    → ability to overcome distracting stimuli



- **the REACTION TIME TEST** (RTT)
  - **goal:** to click as quickly as possible when a target (circle) occurred on a computer screen (index/middle finger, dominant/non–dominant hand)
- **WORKING MEMORY TEST** (WMT) [6]
  - **goal:** repeat a sequence of presented digits in the same or reverse order

    1. 6 3
    2. 2 5 9
    3. 1 8 6 2
    ...
- **T–MENSTAT QUESTIONNAIRE** [7]
  - subjective level of energy and motivation, fatigue, frustration and drowsiness
  - before and after the cognitive tests (T–MENSTAT_A, T–MENSTAT_B)

RESULTS – "STATIC APPROACH"

cognitive test	sleep variable	Spearman ρ	p–value
FMAT_4,6	eff	< -0.52	< 0.028
FMAT_5,6	sl	> 0.50	< 0.035
LANT_OF	sl_rem	- 0.66	0.003
LANT_RVF_OF	tst_rem	0.55	0.017
RTT_2,3,4,Min	tst_N1	> 0.53	< 0.014
TMENSTAT_A_2,3	wtsp	> 0.43	< 0.039
TMENSTAT_A_3	tst_REM	- 0.42	0.047
TMENSTAT_B_1	tst_N3	0.61	0.006

RESULTS – "DYNAMIC APPROACH"

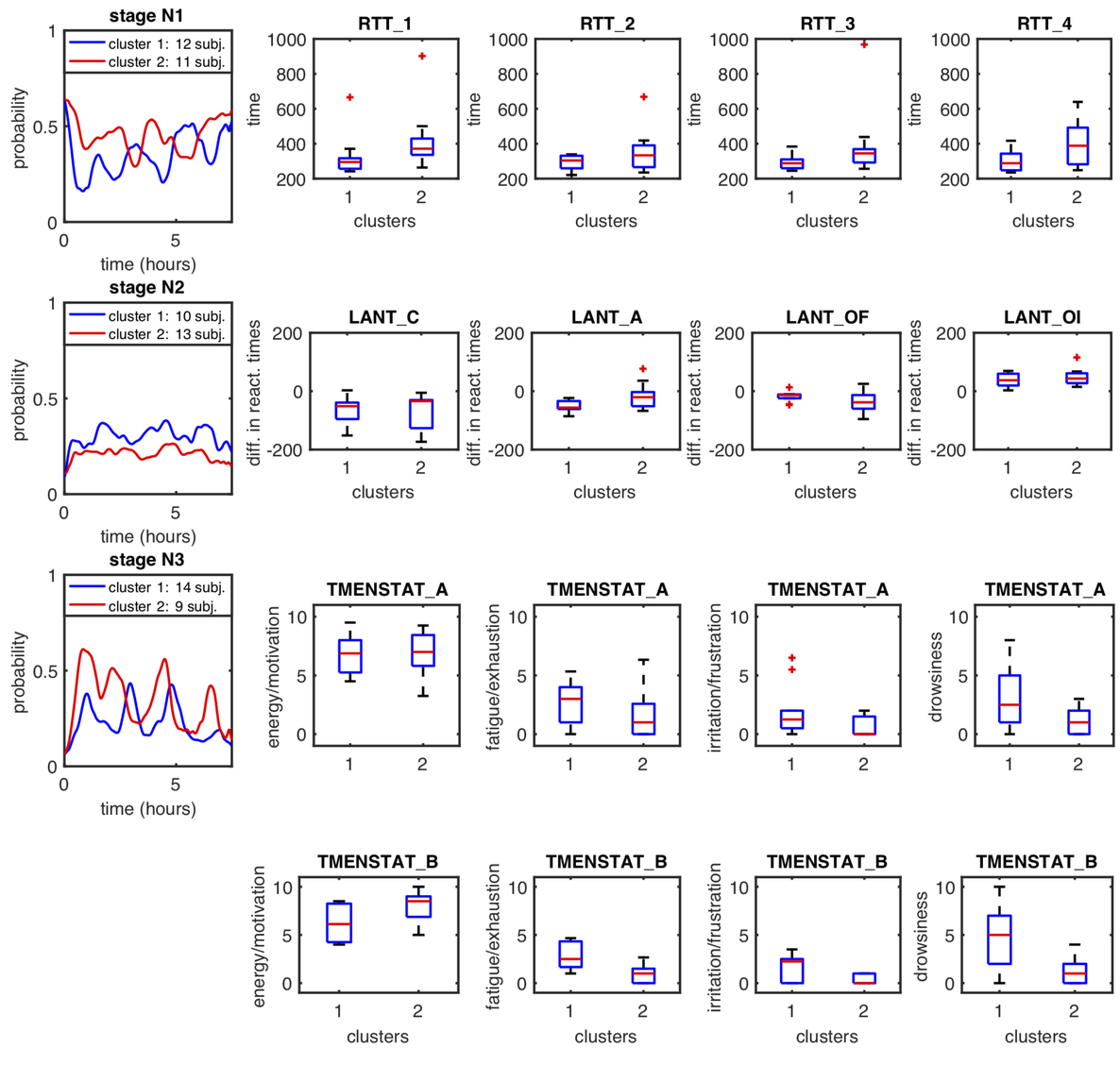


Figure 2: Cluster analysis of the sleep probabilistic curves of the N1, N2 and N3 sleep stages.

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CONCLUSION

"Static" and "dynamic" approach have provided comprehensive insight into relationships between the sleep pattern and cognitive tests.
The advantage of the sleep probabilistic curves analysis, "dynamic" approach:

- Deeper understanding of the sleep dynamics (Figure 2).
- Allows using advanced techniques of mathematical statistics.

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