

Innovative Solution for Sleep Apnea Diagnosis & Automatic sleep stage classification

Project Status

- Technology prototype developed & successfully tested on large number of datasets
- Ready for pilot production, and clinical evaluation

Benefits

- Outstanding diagnostic accuracy with minimal sensor count
- Patient comfort: Simple, textile headgear/headband, suitable for self-use at home
- Cost-effective manufacturing, reduced component complexity
- Automatic sleep stage classification

Patents

- Headgear patent families [EP4514205A1](#) and US, JP, CA counterpart [US12303691B2](#) – granted EP, JP, CA counterpart
- Sleep stage patent families [EP3946003A1](#) and [EP4221569A1](#) & US, JP, CA counterparts

Offer

- The technology can be licensed or assigned
- Collaboration regarding further development

Scientists from University Medical Center Mainz (Germany) have developed a pioneering method for fully automated detection and grading of sleep apnea based on wearable EEG/EMG technology. The system replaces conventional, complex polysomnographic setups with a simple, comfortable headgear – either as a cap or headband – which provides precise diagnostic and therapeutic options. The technology markedly reduces patient discomfort, streamlines data acquisition, and enables faster, objective analysis for optimal clinical outcomes.

Additionally the scientists developed a new method for semi- or fully-automatic sleep stage classification with very high accuracy; the visual classification of sleep stages could become obsolete.

Obstructive sleep apnea (OSA) is a common sleep disorder marked by frequent respiratory interruptions, which can lead to serious health consequences if untreated. Standard diagnosis relies on overnight polysomnography with numerous sensors, leading to long patient preparation and evaluation times and often disturbing the patient's natural sleep environment. The newly invented headgear is designed for self-use at home, eliminating the need for complex polysomnography in a sleep laboratory. The device incorporates only a couple of electrodes: two for collecting central EEG signals at the international C3 & C4 positions, and only optionally two for EMG recording of chin muscle, essential for differentiating sleep stages and apnea severity. All electrodes are seamlessly integrated into the textile headgear, which features secure, comfortable fixation with specially designed chin straps. Reference and ground electrodes are included for improved signal quality.



Schematic representation of the headgear and the procedure

This minimal-sensor approach allows accurate, automatic detection of apnea events and their severity without interfering with natural sleep. Data can be transmitted wirelessly to an evaluation unit, enabling real-time or offline processing. A built-in data processing module utilizes advanced correlation between the signals to identify respiratory disturbances, classify sleep stages, and index sleep apnea severity, entirely automatically or with optional additional expert evaluation (human in the loop).

In addition, a new approach of semi- or fully-automatic sleep stage classification delivers outstanding accuracy of more than 90% for each of the five sleep stages using only two surface electroencephalogram (EEG) signals. Very time-consuming manual classification will be eliminated, and results can be easily compared. The diagnosis of sleep disorders can be improved and standardized facilitating optimal therapy recommendations.

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