DETECTION OF SLEEP PATTERNS OF ELECTROENCEPHALOGRAM USING SELF-ORGANIZING FEATURE MAP AND LEARNING VECTOR QUANTIZATION

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ABSTRACT

Performance of Self-Organizing Feature Maps (SOFM) of varying sizes along with Learning Vector Quantizers (LVQ) in detecting sleep-wake stages in rats has been investigated in this study. Using continuous three channel polygraphic signals such as EEG (electroencephalogram), EOG (Electrooculogram) and EMG (Electromyogram), data were recorded from conscious rats for eight hours during day time. Performance of artificial neural network (ANN) in recognizing three sleep-wake stages has also been evaluated using unsupervised learning algorithms on raw EEG data. Performance evaluation employs two decay functions of learning rate and neighborhood size, three neighborhood tapering schemes, and different training iterations. The effect of LVQ after the initial SOFM training seems explicit, which gives rise to considerable improvements in performance in terms of selectivity and sensitivity. Recognition rate for SWS is observed to be higher. Fine-tuning with LVQ1 after SOFM training results in an increase of 5.92% in AWAKE, 1.62% in SWS and 9.61% in REM. Percentage recognition rate also improves for other cases. When Gaussian taper function is applied, LVQ1 produces (5.48% for AWAKE, 5.14% for SWS and 5.54% for REM) more as compared to unturned SOFM. For quadratic function, it turns out to be 6.34% for AWAKE, 4.17 % for SWS and 5.27% for REM. Non-uniform taper provides a substantially better performance than uniform taper in many of the simulations.

KEYWORDS: SOFM, LVQ, ANN, Sleep-wake states