「校際傑出學術論文授權暨發表會」

論文摘要表

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論文名稱	單通道腦波自動睡眠分期及監測系統之開發
英文論文名稱	Development of an Automated Sleep Staging and Monitoring System Using Single Channel EEG
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系所名稱	電機所
學年度	100 年
語文別	英文

中文關鍵詞:
腦波，睡眠分期，樣本熵，支持向量機

外文關鍵詞
EEG, Sleep stage classification, Sample entropy, Support vector machine

中文摘要

睡眠在每一個人的生活當中是非常重要且關鍵的事情。近幾十年來，由於社會的進步，許多人有睡眠障礙，長期下來引起了許多的疾病。因此，本研究的主要目的是發展一個以 LabVIEW 為基礎的自動睡眠分期與監控系統。本系統

之人機界面（GUI）輸出可協助醫生加速睡眠分期之判定以及睡眠障礙之檢測。另一方面，患者亦可藉由輸出來了解他們的睡眠情形。此外，本系統只使用單通道腦波檢測來做睡眠分期，相較於傳統的 Polysomnograph 儀，可大大減少睡眠檢測時所帶給患者的不適。

本系統使用頻率分析、樣本熵和小波分析做為睡眠分期的初步分析，這三種方法可以分析各個睡眠階段之個別特性，但不能成為整體睡眠分期之有效工具。因此，本系統以支持向量機（SVM）分類演算法進行睡眠分期。與神經網絡技術相比，SVM 有更好的功能並需要較少的參數調整。此外，LabVIEW 的人機界面可以顯示一個或多個睡眠分期圖與重要相關分析指數，這些資訊可幫助醫生和患者了解睡眠的狀況。本系統之評估是從 Physiobank 資料庫取得 8 筆睡眠腦波數據，並隨機採樣分段(Epoch)訓練測試後分析比較，結果顯示其平均準確度為 83.27%；而各分期之清醒、淺睡、深睡和快速眼動期的準確度各為 85.04%、65.34%、93.33%和 92.41%。未來，本系統可藉由優化參數調整及用更多的測試數據再提高睡眠分期的準確度。

英文摘要

Sleep is an essential and crucial event in the lives of every human being. However due to recent advancement in society it also brought in a new tide of disease in the form of sleep disorders. Therefore, looking into sleep is one purpose of this study. The research aims to develop an automated LabVIEW-based sleep stage classification and monitoring system with a user friendly graphic user interface (GUI) to help doctors save time in classifying sleep stages. Patients on the other hand get a picture of their condition through viewing the interface and to help them know how well they slept the night of the test. In addition, the research will be using only a single parameter oriented recording technology in the form of single channel EEG to do the sleep stage classification. Compared to the traditional Polysomnograph it will reduce the discomfort experienced by the patients every time they undergo sleep examination.

The research used power spectrum analysis, sample entropy and wavelet transform as a preliminary step for sleep stage classification. These three parameters can show indications for each respective sleep stage but are not very efficient to be used for sleep stage classification individually. Moreover, SVM has good dependence on data and it requires fewer parameters to tune compared to the conventional neural networks. Thus, the data taken from these three analyses are used corporately as instances to a support vector machine (SVM) classification algorithm to perform sleep stage classification. For the system, the GUI platform can present single or multiple hypnogram/s and several key sleep indices that can be beneficial to doctors

and patients in understanding certain sleep conditions. Based from the data taken from Physiobank, the developed system was trained using randomly selected epochs from the combined EEG database. Each EEG database are then tested individually and showed an average accuracy of 83.27% for 8 sets of database. In addition, individual results in classifying wake, light sleep, slow wave sleep and rapid eye movement stages are 85.04%, 65.34%, 93.33%, and 92.41% respectively. In the future, the project can still be tuned by refining the input instances to the classification algorithm and having more test data to improve accuracy in classifying sleep stage.