ON DATA SCIENCE APPROACH FOR PARKINSON'S DISEASE DETECTION

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論文内容の要旨

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専　　攻　計算科学

論文題目（外国語の場合は，その和訳を併記すること。）

ON DATA SCIENCE APPROACH FOR PARKINSON'S DISEASE DETECTION

和訳：　データサイエンスのアプローチによるパーキンソン検査に関する研究開発

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（注）2，000 字～4，000 字でまとめること。

Parkinson’s disease, hereinafter referred to as PD, is a common neurodegenerative disease with distinct characteristics. The clinical manifestations of Parkinson’s disease patients are mainly motor symptoms such as static tremor, bradykinesia, myotonia and gait disorder, accompanied by a variety of non-motor symptoms such as anxiety, depression, sleep disorder and cognitive disorder. Because the pathogenesis is unclear and there are great differences among individual patients, the disease cannot be cured and the treatment effect is limited. With the aggravation of the disease, patients gradually lose the ability to take care of themselves, further affecting the quality of life and eventually endangering their lives. Due to the lack of quantitative evaluation technology, diagnostic decision-making technology and relevant multi-modal data platform, PD is currently facing two important clinical problems: early diagnosis and personalized treatment. In order to solve these problems, in this study, we propose a novel date science approach for evidence-based PD detection.

We first established a multi-modal data and intelligent analysis platform named GYENNO PD CIS, with the main purpose of realizing data standardization, evaluation objectification and diagnosis standardization, and building the foundation for personalized treatment and continuous management. Meanwhile, for single-center and multi-center clinical research, clinical data management and multi-center management are be provided. On this basis, we introduced a practical application of scale rating based on machine vision technology, combined with the data platform to form an automatic path template from quantitative evaluation to data storage.

Secondly, aiming at FoG (freezing of gait), a typical gait disorder of PD, we established a detection method based on wearable sensors, and explored the optimal sensor configuration, feature extraction and feature screening based on performance, cost and applicability. By the wearable sensor of the patient's left shank and its relevant 35 features, we constructed a FoG detection model with 78.39% sensitivity, 91.66% specificity and 88.09% accuracy.

Finally, in terms of the symptom of speech, which has specific changes due to abnormal vocal cord muscles in the early stage of PD, we explored a method for early detection of PD by time-series dynamic speech feature capture using bidirectional long-short term memory (LSTM) model. The dynamic speech features are measured based on computing the energy content in the transition from unvoiced to voiced segments (onset), and in the transition from voiced to unvoiced segments (offset). Finally, we tested the performance of this early detection model by 10-fold cross-validation and division of the data set into each individual sample without overlapping. The detection performance for early PD reached 85.19% sensitivity, 76.67% specificity and 75.56% accuracy, which is significantly better than the traditional machine learning model based on static features.