Automated seizure detection for remote monitoring

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CHAPTER 12

Summary

In this thesis, we focused on database-independent, cross-database evaluation of classification of seizure for remote monitoring of epilepsy patients along with the multi-class classification of epileptic seizures. In this thesis, we contribute novel features and the FBC method to the scientific community.

Chapter 1 gives the general introduction about the thesis including problem statement, objective, and outline of the thesis. In Chapters 2 and 3, we showed that the MD and SDI features are computationally efficient against state-of-the-art methods and suitable for seizure detection. Wavelet-based entropies were studied and optimal sub-bands using different mother wavelets were identified for seizure detection in Chapters 4 and 5. Following the previous results of SDI and MD, in Chapter 6, we proposed AM-FBC to overcome the inter-subject variability in feature distribution. Finally, a cross-database evaluation was performed in Chapter 7 using five EEG databases collected from different centers. We used AM-FBC to overcome the inter-databases variability in feature distribution, smoothing of train and test data and post-processing to achieve significant results. The cross-database model was used to build a mobile-based EEG analysis for seizure monitoring. Chapter 9 describes transfer learning and CNN based multi-class classification of seizure types. Overall, the image features approach outperformed the transfer learning approach. Finally, this thesis is concluded with the feasibility of a mobile-based app for remote monitoring of epilepsy patients using the database-independent optimized algorithm in Chapter 10.

The results of this thesis contribute towards the clinical aspect in terms of reducing the neurologist burden in reviewing long-term EEG, speed up the treatment procedure and monitor epilepsy patients using a mobile app.

Samenvatting

In dit proefschrift hebben we ons gericht op database-onafhankelijke, databaseoverschrijdende evaluatie ten behoeve van classificatie van epileptische aanvallen voor remote monitoring bij epilepsiepatiënten.

Hoofdstuk 1 geeft de algemene inleiding over de scriptie inclusief probleemstelling, doelstelling en overzicht van de scriptie. In de Hoofdstukken 2 en 3 hebben we aangetoond dat de MD- en SDI-functies rekenkundig efficiënt zijn en geschikt voor automatische aanvals detectie. Op wavelet gebaseerde entropieën werden bestudeerd en geoptimaliseerde subbanden met behulp van verschillende moederwavelets werden geïdentificeerd voor aanvalssdetectie in Hoofdstukken 4 en 5. In navolging van de eerdere resultaten van SDI en MD, in Hoofdstuk 6, stelden we AM-FBC voor om de variabiliteit tussen de onderwerpen in de distributie van functies te ondervangen. Ten slotte werd een databaseoverschrijdende evaluatie uitgevoerd in Hoofdstuk 7 met behulp van vijf EEG-databases verzameld uit verschillende centra. We hebben AM-FBC gebruikt om de interdatabase-variabiliteit bij de distributie van functies, en het trainen en testen van gegevens en nabewerking te verbeteren om significante resultaten te bereiken. Het cross-database model werd gebruikt om een mobiele toepassing voor EEG-analyse te bouwen. Hoofdstuk 9 beschrijft transfer learning en CNN-gebaseerde multi-class classificatie of aanvals types. Ten slotte wordt dit proefschrift afgesloten met de haalbaarheid van een mobiele app voor monitoring op afstand in epilepsiepatiënten met behulp van het database-onafhankelijke geoptimaliseerde algoritme in Hoofdstuk 10.