Application of Topological Data Analysis to Delirium Detection

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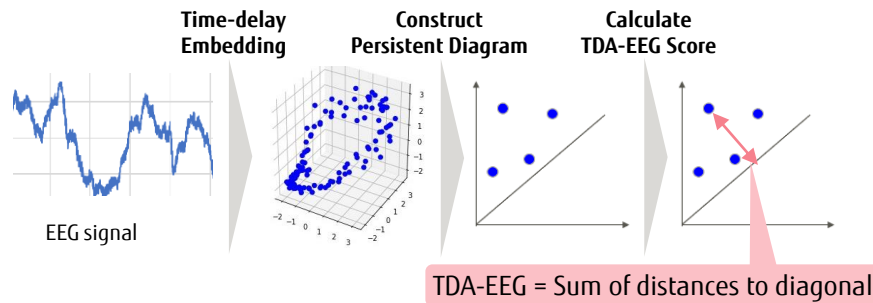1. Fujitsu Laboratories Ltd. 2. University of Iowa

Introduction

- Delirium is a mental state where somebody becomes excited and not able to think or speak clearly.
- There is a demand for an automated delirium detection method from EEG signals.
- We propose a novel scoring algorithm based on TDA.

Methodology

- With time-delay embedding and persistent homology, we define a new score called **TDA-EEG**.

Time-delay Embedding → Construct Persistent Diagram → Calculate TDA-EEG Score

EEG signal

TDA-EEG = Sum of distances to diagonal

Experiments and Results

- Dataset: EEG data for patient admitted to the Univ. of Iowa Hospitals & Clinics (positive:58, negative:79).
- Compare TDA-EEG with existing methods based on frequency analysis.

TDA-EEG outperformed the other methods

TDA-EEG   (AUC = 0.80)
Shinozaki et al.(AUC = 0.72)
Numan et al.   (AUC = 0.66)
Adaboost   (AUC = 0.69)
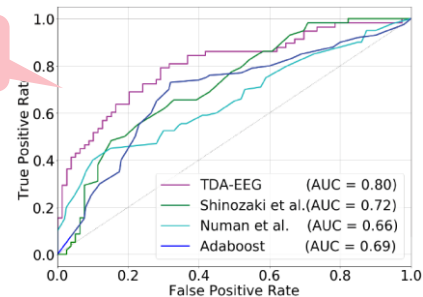
Conclusion

- Proposed a TDA-based method for detecting delirium from one-channel EEG.
- Our method achieved higher performance.
- This enables early delirium detection and provides appropriate medical services.