Epileptic Seizure Prediction using Rotation Forest in a Parallel Environment

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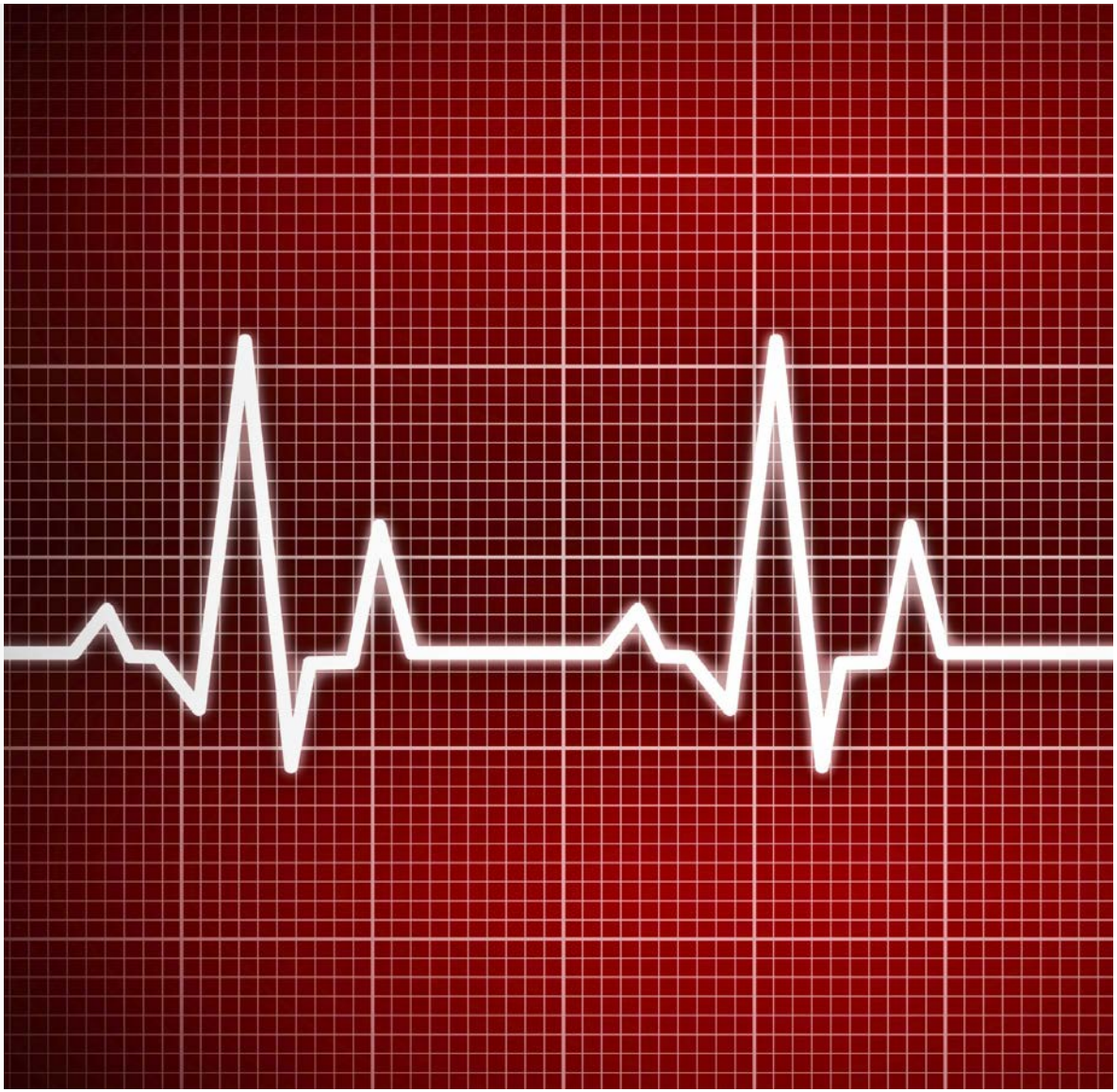

Outline

- Motivations
- EEG
- Parallel Processing with MATLAB
- Results
- Discussion
- Conclusion

Motivations

- Motivations of ensemble methods
  - Ensemble model improves accuracy and robustness over single model methods
  - Applications:
    - distributed computing
    - privacy-preserving applications
    - large-scale data with reusable models
    - multiple sources of data
  - Efficiency: a complex problem can be decomposed into multiple sub-problems that are easier to understand and solve (divide-and-conquer approach)

Electroencephalogram (EEG)

- …is a tool for evaluating the physiological state of the brain.
- …offers excellent spatial and temporal resolution to characterize rapidly changing electrical activity of brain activation
- …captures voltage potentials produced by brain cells while communicating.
- In an EEG, electrodes are implanted in deep brain or placed on the scalp over multiple areas of the brain to detect and record patterns of electrical activity and check for abnormalities.

Epileptic Seizures

- Seizures usually occur spontaneously, in the absence of external triggers.
- Seizures cause temporary disturbances of brain functions such as motor control, responsiveness and recall which typically last from seconds to a few minutes.
- Seizures may be followed by a post-ictal period of confusion or impaired sensorial that can persist for several hours.

Signal Acquisition

EEG Signal

Data Segmentation

Raw Signal in Segments

Denoising with MSPCA

Denoised Signal

Feature Extraction with WPD

WPD Subbands

Dimension Reduction

Reduced Feature Vector

Classification with RoF

Prediction

Seizure Warning

Parallel Processing with MATLAB

- MATLAB's Parallel Computing Toolbox is used to solve computational problems employing multicore processors.
- High-level parallel for loops, special array types, and parallelized numerical algorithms allow to parallelize MATLAB applications
- You can run the same applications on a computer cluster or a grid computing service using MATLAB Distributed Computing Server™ without modifying the code

Single Program Multiple Data (spmd)

- The single program multiple data (spmd) language construct allows seamless interleaving of serial and parallel programming.
- The spmd statement lets you define a block of code to run simultaneously on multiple workers.
- Variables assigned inside the spmd statement on the workers allow direct access to their values from the client by reference via *Composite* objects.

Interactive Parallel Computation with pmode

- pmode lets you work interactively with a communicating job running simultaneously on several workers.
- Commands you type at the pmode prompt in the Parallel Command Window are executed on all workers at the same time.
- Each worker executes the commands in its own workspace on its own variables.
- In contrast to spmd, pmode provides a desktop with a display for each worker running the job, where you can enter commands, access each worker's workspace, etc.

RESULTS

Parallel Processing Results

- We test three types of MATLAB computing:
  - Running MATLAB code normally,
  - Multithreaded parallelism (MATLAB parallel)
  - Explicit parallelism (Code parallel).
- One instance of MATLAB automatically creates multiple concurrent instruction streams in multithreaded parallelism.
- Multiple processors or cores, sharing the memory of a single computer, execute these streams.
- In explicit parallelism, numerous examples of MATLAB run on several processors or computers, mostly with distinct memories, and concurrently execute a single MATLAB command.
- New programming concepts, including parallel loops and distributed arrays, describe the parallelism

Results

Patient	Normal execution	MATLAB parallel	Code parallel
Patient1	215.08	211.05	117.7
Patient2	247.91	245.52	124.93
Patient3	228.6	223.88	111.77
Patient4	232.61	229.63	123.02
Patient5	233.09	231.84	119.28

Questions

Thank You

References

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