The UCC neonatal seizure detector: System outline and results

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- Pre-processing consists of filtering and downsampling the EEG
- 55 features are then extracted per channel
- A per channel classification is performed prior to recombination of the multichannel decisions

**UK Int. Property Off. (patent pending):** A Method of Analysing an Electroencephalogram (EEG) Signal
Classification

Support vector machines
- Discriminative
- Non-parametric

Gaussian Mixture Models
- Generative
- Parametric
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Introduction
System Overview
Results
Performance review

IEEE EMBC, 2009: An SVM-based system and it’s performance for detection of seizures in neonates
INSTICC/IEEE Int. Conf. on Bio. Sys. and Sig. Proc. (submitted): Validation of an automated seizure detection system on healthy babies

SVM Parameters:

- Generalisation parameter
- Gaussian kernel parameter
- Sigmoid function

Feature Vector $\rightarrow$ SVM $\rightarrow$ Sigmoid Function $\rightarrow$ Probability of Seizure
GMM Parameters:

- LDA/PCA output dimension
- Number of components per GMM
- Covariance type

**IEEE MLSP, 2009**: A Gaussian mixture model based statistical classification system for neonatal seizure detection
2 routines are used in the postprocessing stage:

- A moving average filter is applied to the posterior probability of seizure.
- Seizures decisions are expanded in time using a collar operation.
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IEEE WISP, 2009: A comparison of generative and discriminative approaches in automated neonatal seizure detection

**Sensitivity** = % Seizure epochs correctly classified

**Specificity** = % Non-seizure epochs correctly classified
**Precision** = % Correct positive decisions

**Sensitivity/Recall** = % Seizure epochs correctly classified
GDR comparison

GDR as a function of FD/h

- GDR = % seizures detected
- FD/h = Mean number of false detections per hour
- Mean duration of false detections
Comparison to other work

<table>
<thead>
<tr>
<th>Method</th>
<th>GDR (%)</th>
<th>FD/h</th>
<th>Sensitivity (%)</th>
<th>Specificity (%)</th>
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<td>Temko et al. (2009)</td>
<td>89</td>
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<td>Greene et al (2008)</td>
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<td>69</td>
<td>80</td>
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Our system can easily be tuned to facilitate comparison with other works

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Findings and future work

Conclusions

- The current system has state of the art performance in the field.
- The probabilistic framework allows flexible control of final decision.
- A key attribute of the system is the use of diverse features from different fields.
- Per channel probabilistic output can be generated and displayed to provide additional information to the clinician.

Future work

- Fusion of classifiers to improve detection rates.
- Information flow reduction (feature selection, etc) towards a real time implementation.