INTRODUCTION. Motivation and Goal

- Previous works found significance difference between controls and Multiple Sclerosis (MS) definitive subjects using amplitudes and latencies from mfVEP (1,4).
- Appropriate preprocessing of biomedical signals improves the patient diagnosis based on the results of signal classification.
- The goal of automatic classification is to predict labels for new test examples based on previous relations label-example.
- This work studies the performance of automatic classification applied to mfVEP signals using a k-nearest neighbor’s algorithm.

The records and analysis

- Monocular mfVEP recordings are obtained using VERIS software 5.9 (Electro-Diagnostic Imaging, San Mateo, USA). The stimulus was a scaled dartboard with a diameter of 44.5 cm, containing 60 sectors, each with 16 checks, (8 white / 8 black).
- The records are amplified with the low and high frequency cut-offs set at 3 and 100 Hz, and sampled at 1200 Hz. Impedance was <2 KΩ for all electrodes. The length of each record is 500 ms.

METHOD. Amplitude measurements

- The signal to noise ratio (SNR) is the parameter used to quantify the quality of the mfVEP recordings (2,3).
- The recordings are divided in: signal window (45-150 ms) and noise window (325-450 ms). The SNR is computed as the Root Mean Square (RMS) of the signal windows divided by the RMS of the noise window mean of the 60 sectors.

METHOD. Latency measurements

- Latency was measured as the temporal shift producing the best cross-correlation value between:
  - Each individual and a template constructed by averaging responses from a control database (Monocular Latency =Mo_La)
  - The corresponding responses of each eye (Interocular Latency =In_La)

METHOD. Features vector

- For each subject, a features vector is constructed with the information of SNR, Mo_La and In_La of each sector.

RESULTS

Confusion matrix for each classification:

<table>
<thead>
<tr>
<th>Subject</th>
<th>Features vector</th>
<th>Label 1</th>
<th>Label 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>FV(Control 1_OD)</td>
<td>CON</td>
<td>--</td>
</tr>
<tr>
<td>Control</td>
<td>FV(Control 2_OD)</td>
<td>CON</td>
<td>--</td>
</tr>
<tr>
<td>MS 1_OD</td>
<td>FV(MS 1_OD)</td>
<td>MS</td>
<td>notON</td>
</tr>
<tr>
<td>MS 2_OD</td>
<td>FV(MS 2_OD)</td>
<td>MS</td>
<td>notON</td>
</tr>
</tbody>
</table>

To make a prediction for a test eye:
- Compute its Euclidean distance to every feature vector.
- Keep the k closest feature vectors, where k ≥ 1 is a fixed integer.
- Look for the label that is most common among these eyes. This label is the prediction for this test example.

DISCUSSION

- Good classification accuracy results were obtained between control and patients.
- Moderate classification accuracy for ON-noON due to subclinical affection.
- Our results suggest that automatic classifier as k-NN used in combination with the actual techniques (MRI, OCT) could improve multiple sclerosis diagnosis.
- Proposed future works:
  - use more sophisticated automatic classifier: neural networks.
  - comparison between different commercial register equipment (example: VERIS vs. ROLAND).
  - Study MS-risk patients.

LITERATURE


Acknowledgments

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