3D Mapping and Visualization Tool for Clinical EEG Data

Background

“A Solution for the Epilepsy Treatment Problem of Today”

- Provide improved visualization techniques for epilepsy treatment and research

- Motivation:
  - Clinical Need: Current software tools are inadequate for visualization of the electrode placement in the patient’s brain.
  - Scientific Problem: Lack of a well-developed visualization tool limits the translation aspects of epilepsy.

- Research Needs

- Visualization Techniques

Objectives and Specifications

- Objectives: Design a software suite for clinicians and researchers to:
  - Provide an accurate representation of electrode placement and 3D models of the patient’s brain.
  - Provide clinical events and features of EEG data on electrodes.
  - Allow users to see the same temporal evolution of events and data on computed images.

- Specifications: The software suite should be capable of:
  - Generating a patient-specific 3D brain model from EEG data.
  - Overlaying EEG electrodes data on the 3D models.
  - Displaying events and data as user-specified images.

Program Process Diagram

Results

Demonstration of the software allowing the user to select the type of electrode and displays a heatmap representing an EEG feature on it.

Specifications and Performance

<table>
<thead>
<tr>
<th>Specification</th>
<th>Perceived (Subject)</th>
<th>Desired (Clinical Performance)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct EEG data to printable 3D model.</td>
<td>Correct EEG to printable 3D model.</td>
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<tr>
<td>Specimen electrode placement on 3D model.</td>
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<td>Electrode availability</td>
<td>All electrodes used in lab.</td>
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<td>Electrode position and orientation with respect to EEG data to load a solution.</td>
<td>Electrode position in MATLAB, editable at later time.</td>
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<tr>
<td>Electrode feature values per electrode into reading.</td>
<td>Electrode representing feature values.</td>
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<tr>
<td>Temperature data per electrode.</td>
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Conclusion

- Software meets most specifications set out for the project.
- Demonstrated proof-of-concept that our visualization would improve current clinical procedure.
- Encountered mathematical and computational challenges in the way.

Future work:
- Use the skull-wrapping algorithm for better surface extraction.
- Improve algorithm for co-registering electrodes with extracted surface.

Acknowledgements:
- Dr. Brian Litt, Dr. Paul Yashkevich, Justin Blaisoe, Drama, Waldren, Dr. Kate Davis.