Detecting Periodic Limb Movements with Off-the-shelf Accelerometers

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Periodic Limb movements

- Affects sleep quality
- Related to sleep apnea, COPD, hypertension
Gold Standard
polysomnography (PSG): lab, expensive, sleep over
Can we use accelerometers?

- Cheap, easy to use
  - Follow up of patients after therapy
  - Self assessment
Subjects and materials

- Two patients at Clinic Bad Reichenhall
- PSG: Philips Respironics Alice 5
- Accelerometer: Actigraph GT3X
  - 30Hz, 3-axis, pre-filtered
  - Both legs at ankle
Software

• code.google.com/p/movyzer/

\[ |VMU| = \sqrt{x^2 + y^2 + z^2} \]

• Similarity function

(1) GT3X Graph (left leg), (2) GT3X Graph (right leg), (3) PSG Graph, (4) Log field, (5) Parameters
## Results

<table>
<thead>
<tr>
<th>Subject</th>
<th>Age</th>
<th>Gender</th>
<th>Number of LM events</th>
<th>Maximal similarity</th>
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</thead>
<tbody>
<tr>
<td>S1</td>
<td>51</td>
<td>M</td>
<td>655</td>
<td>8%</td>
</tr>
<tr>
<td>S2</td>
<td>63</td>
<td>F</td>
<td>181</td>
<td>5%</td>
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</tbody>
</table>

![Graph showing similarity measurement](image)
Discussion

• 8% similarity: far from relevant for medical applications
• Other authors have reported underestimation of accelerometers
  – But we are in contrast
• higher sampling: 100hz
Unpublished results

<table>
<thead>
<tr>
<th></th>
<th>0.001G</th>
<th>0.01G</th>
<th>0.05G</th>
<th>0.1G</th>
<th>0.5G</th>
<th>1G</th>
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<tbody>
<tr>
<td>GT3X+</td>
<td>-</td>
<td>1125</td>
<td>1403</td>
<td>756</td>
<td>5</td>
<td>-</td>
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<tr>
<td>PSG</td>
<td>1283</td>
<td>1283</td>
<td>1283</td>
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<td>detected</td>
<td>0%</td>
<td>87.7%</td>
<td>109.4%</td>
<td>58.9%</td>
<td>0.4%</td>
<td>0%</td>
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