Automated earthquake reconnaissance using smart devices: potential and hurdles

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1. Motivation

- Acceleration provided by sensors in smart devices if placed on an appropriate surface in the building
- Use this data to compute Interstory drift ratios (IDRs)
- Enable automated reconnaissance after earthquakes
- Smart devices may not be constrained or are on furniture that itself slides during seismic motion
2. Objective

- Identify **sliding/sticking** motions from the measured acceleration
- Sliding acceleration is a constant and form **plateau shape** during sliding, when Coulomb friction ($\ddot{u}_x = \mu_k g$) is assumed to govern

**Challenge**: Limitation of conventional edge detection in signal processing field

![Diagram showing a block on a surface with forces and acceleration over time]
3. PROPOSED SLIDING DETECTION METHOD

- Samsung galaxy S7 smartphone and 3D motion capture system
- Kernel Discriminant Analysis (KDA) to improve class separation
- Artificial Neural Network classifier
4. Experiment Setup and data analysis

- Customized shaking table in 1D motion is used
The original four features provided an average sliding motion recognition rate of up to 87%. KDA increase this slightly up to 89%.

<table>
<thead>
<tr>
<th></th>
<th>Original features</th>
<th>KDA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Predicted</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>sticking</td>
<td>10.5% 2.8% 93.5%</td>
<td>8.8% 2.2% 95.1%</td>
</tr>
<tr>
<td>sliding</td>
<td>40.8% 45.9% 81.4%</td>
<td>42.5% 46.5% 84.1%</td>
</tr>
<tr>
<td><strong>Actual</strong></td>
<td>79.5% 94.2% 86.7%</td>
<td>82.9% 95.5% 89.0%</td>
</tr>
</tbody>
</table>
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Today Poster Session:

- **Time**: 5:15 – 7:00 pm
- **Room**: Pasadena (Exhibit Hall)
- **Poster location**: 100 (ID 662)