Tremor Detection
Using Motion Filtering and SVM

Bilge Soran, Jenq-Neng Hwang, Linda Shapiro, ICPR, 2012
Tremor Detection Using Motion Filtering and SVM [Soran et al., ICPR’12]

• Problem: Automatic hand tremor detection using a static camera

• Motivation: Providing doctors objective information for diagnosis
Related Work

- [Garg et al., 2009] categorize the hand gesture recognition approaches into 3D model-based and appearance-based.

- [Murthy and Jadon, 2009] adopted an appearance based approach based on low-level hand features from intensity images.

- [Uhrikova et al., 2009] measures the hand tremor frequencies. They compared their calculated frequencies with those measured by an accelerometer.
Method

1. Personalized Skin Detection & Blob Extraction
2. Optical Flow Calculation & Feature Extraction
3. Classification with SVM
Input:
• Video of a patient waving his hand for ~3 sec

Method:
• Apply skin color thresholds
• Compute optical-flow and extract moving regions
• Merge regions and compute color histograms
• Fit Gaussian function to use as personalized skin model
• Perform Blob Detection, discard small regions.
For each blob compute optical-flow direction and direction change using 3 consecutive frames:

1. Calculate sum of motion direction change: +19
2. The sign of the sum shows the general direction change of the flow: up or down.
3. Sort the direction changes descending. If sum is (-) use average direction change of the last 25% points, else use that of the first 25% points as the feature component.

4. Start the process from the next frame with a new blob extraction, since optical flow accumulates error.

5. Apply Discrete Cosine Transform

6. Apply MDL Discretization [Fayyad and Irani, 1993] obtaining final Motion Direction Change (MDC) features.
Dataset

- 90 positive (simulating tremor), 83 negative
- Static camera, 30 fps
- Indoors, static background
- 6 human subjects
### % of MDC Features from Hand Region

<table>
<thead>
<tr>
<th>%</th>
<th>LOOCV</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 %</td>
<td>79.2 %</td>
</tr>
<tr>
<td>10 % with MDL discretization</td>
<td>89.6 %</td>
</tr>
<tr>
<td>25 %</td>
<td>86.7 %</td>
</tr>
<tr>
<td>25 % with MDL discretization</td>
<td><strong>95.4 %</strong></td>
</tr>
</tbody>
</table>
Discussion

• Requires a single short video, minimizes diagnostic discomfort
• Automatically detects hand tremors with 95.4% accuracy using LOOCV
• Distinguishes very subtle motions and tremor-like movements from tremors
• False negative rate is close to zero