**Tree Leaf Classification for a Mobile Field Guide**

David Knight, James Painter, Matthew Potter
Department of Electrical Engineering, Stanford University

**Motivation**
- Species identification for hikers, park rangers, backyard enthusiasts
- Automated sorting for large-scale research applications
- Targeted crop spraying (e.g. weeds)

**Related Work**

**Leaf Classifiers**
- Aspect ratio
- Rectangularity
- Convex hull area ratio
- Convex hull perimeter ratio
- Sphericity
- Circularity
- Eccentricity
- Form factor
- Regional moment of inertia (4-D)
- Angle code histogram (5-D)

**Experimental Results**

**LeafR: Mobile App Implementation**
- **Platform**
  - Motorola DROID
  - Google Android 2.x
- **Features**
  - Real-time leaf contour overlay in viewfinder
  - Touch-based image rotation
  - Immediate analysis of images from built-in camera
  - On-board processing for use in absence of network coverage

**Platform**
- Match Rate
  - Class 1: 100%
  - Class 2: 100%
  - Class 3: 80%
  - Class 4: 100%
  - Class 5: 93%
  - Class 6: 100%

Leaf class similarity scores; margin is difference between best and second best matches (MATLAB-generated)

Leaf class match scores, Class 1-6 vs. Class 1-6 vs. Score

<table>
<thead>
<tr>
<th>Class 1</th>
<th>Class 2</th>
<th>Class 3</th>
<th>Class 4</th>
<th>Class 5</th>
<th>Class 6</th>
<th>Margin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 1</td>
<td>0.31</td>
<td>0.89</td>
<td>2.44</td>
<td>2.18</td>
<td>2.11</td>
<td>1.71</td>
</tr>
<tr>
<td>Class 2</td>
<td>1.43</td>
<td>0.17</td>
<td>2.23</td>
<td>2.02</td>
<td>1.91</td>
<td>1.49</td>
</tr>
<tr>
<td>Class 3</td>
<td>2.53</td>
<td>2.12</td>
<td>0.53</td>
<td>1.93</td>
<td>1.82</td>
<td>0.88</td>
</tr>
<tr>
<td>Class 4</td>
<td>2.49</td>
<td>2.18</td>
<td>2.05</td>
<td>0.39</td>
<td>0.85</td>
<td>1.61</td>
</tr>
<tr>
<td>Class 5</td>
<td>2.41</td>
<td>2.07</td>
<td>2.10</td>
<td>1.01</td>
<td>0.32</td>
<td>1.55</td>
</tr>
<tr>
<td>Class 6</td>
<td>2.36</td>
<td>1.91</td>
<td>1.15</td>
<td>1.94</td>
<td>1.84</td>
<td>0.24</td>
</tr>
</tbody>
</table>

Leaf class match counts, 90 leaves