Hand Shape Detection and Classification Based on Co-occurrence of Partial Contour Feature
Yutaka YAMADA, Nobutaka SHIMADA and Yoshiaki SHIRAI (Ritsumeikan University)

**Background**
Hand shape is an important element for
- gesture interface
- video surveillance

**Goal:** hand shape detection and classification
- in a complex background
- with partial occlusions by things

**Solutions**
- Represent global hand feature by co-occurrence of local contours

---

**Proposed Method**

**Hand Shape Representation**

- Finger: 3 DoFs x 5
- Wrist: 2 DoFs

**Notation**

- $\Omega = \{c_0, c_1, c_2, \ldots, c_n\}$: codebook of hierarchy level $n$
- $c_i = (c_{i-1}, c_{i-2}, \ldots, X_{i-1, X}, p, q, \theta, \theta')$:
- $\theta$: Angle between the direction of $c_{i-1, X}$ and $c_{i-2, X}$
- $f_{i,j} = ((X_{i,j}), X_{i,j}, \theta_{i,j})$:
- $j$: $i$-th feature of hierarchy level $h$

**Detection and Classification**

- There are too many high level codes

**Constructing a Hierarchical Codebook**

**Hierarchical Codebook made from 972 CGs**

1. Detect local contours $F_0 = \{f_{0,1}, f_{0,2}, \ldots, f_{0,n}\}$ by Oriented Chamfer Matching
2. For $i = 0, 1, \ldots, n$ (i: hierarchy level)
   - For all pairs $f_{i,p}, f_{i,q}$, calculate feature vector $g_{i,p,q} = ((c_{i-1}, c_{i-2}, \ldots, X_{i, X}, p, q, \theta, \theta'))$
   - Match each $g_{i,p,q}$ to codes in $\Omega_{i+1}$
   - Assign the best matched code $c_{i+1, l}$ to $g_{i,p,q}$
   - If the matching error to $c_{i+1, l}$ is less than threshold, add the pair feature $f_{i+1,l} = (c_{i+1, l}, X_{i+1, l}, \theta_{i+1, l})$ to $F_{i+1}$
3. If the assigned code of $f_{i,j}$ is only found in $C(\Omega_{i})$, it means that the $s$-th shape is found at $X_{i,j}$ with direction $\theta_{i,j}$

**Current Works**

- Determine criterion for detection (Extracted high level feature can be regarded as hand)
- Determine criterion for discriminating partially occluded hand from complex background