Artistic paper-cut is a traditional and popular Chinese decorative art which, usually in a very concise two-tone (red foreground and white background) form, has its unique beauty of expressive abstraction. In our approach, a bottom-up phase is first executed to extract information from the input photograph. Then a second top-down phase is used for matching the above proposals with pre-collected representative paper-cut templates created by artists, which are organized using a hierarchical and compositional representation named And-Or Graph (AOG). This is for bringing in prior information to achieve fine details unavailable from the photograph. In addition, a post-processing phase is performed for rendering hair and clothes, and enforcing the connectivity of the foreground which is an important characteristic of artistic paper-cut.

1. REPRESENTATION

**Paper-Cut Templates**
We have asked professional artists to create red-and-white images for portrait photographs using common interactive image processing software, mimicking the paper-cut effects, then manually decompose them into facial components.

**And-Or Graph of Human Portraits**
AOG is a hierarchical (tree-like) and compositional (part-based) model for structural information representation. We use a 3-layer AOG to organize human portrait photographs as well as the dictionary of paper-cut templates. The root node is an And-node corresponding to the generic face, which is decomposed into facial components such as eyebrows, eyes, nose, mouth, etc.; each of them is an Or-node switching among different instantional versions.

**Parse Graph**
By selecting one specific mouth, one specific nose, etc., from the template dictionary, we get an instance of the AOG, named parse graph. An entire face is formed through putting them together.

2. COMPUTATION

1. The Bottom-Up phase
   \[ k = \arg \min_{j} |V(I) - V(I_1)| \]

   AAM key points
   
   Binary sequence of facial parts
   \[ \Gamma = \{ \text{nose, mouth, ...} \} \]

2. The Top-Down phase
   \[ (i, j, ...) = \arg \min_{i,j} d(\Gamma_{i,j}, \Gamma) + \lambda c(\Gamma_{i,j}) \]

3. POST-PROCESSING

   **Hair and Clothes**— For hair, we use a shape context distance metric to find the best contour-fit-hair-template created by artists. As for the clothes, we simply use a boundary-smoothed version of the binary proposal obtained in the bottom-up phase with edges added at its boundary to the background.

   **Connectivity**— To achieve connectivity, we collect a few possible curves with different positions. We randomly turn on some of them until the result is fully connected.

3. EXPERIMENTAL RESULTS

5. REFERENCES


