A. Proof for Algorithm 1

Proposition 1. *In Algorithm 1 when the triangulated graph G' is constructed, if $|P_0P_2| < |P_1P_1'|$, $|P_0P_2| < \sqrt{t_r^2 + b^2}$. ($t_r$ is the threshold of neighborhood energy E_r in Equation 7; b is the width of the user scribble.)*

Proof of Proposition 1. In Algorithm 1, when $v_{i-2}, v_{i-1}, v_i, v_{i+1}$ are considered, $v_i \prec v_{i-2} \Rightarrow P_0 \prec P_2$; $v_{i-1} \prec v_{i+1} \Rightarrow P_1 \prec P_1'$. At the same time, we have $|P_0P_1| < t_r$, $|P_0P_1'| < t_r$, $|P_1P_2| < t_r$ and $|P_0P_2| < |P_1P_1'|$. Projecting the four points P_0, P_1, P_1', P_2 onto the central line of user scribble, it's easy to identify that the distance of the projections of P_0 and P_2 are $< t_r$. Since the width of the user scribble is b, $|P_0P_2| < \sqrt{t_r^2 + b^2}$. □

With Proposition 1, in the output graph G' of Algorithm 1, the distances of all node pairs are within $\sqrt{t_r^2 + b^2}$.

Proposition 2. *In Algorithm 1 when a vertex v_k is eliminated, all the neighbors of v_k are connected in G'.*

Proof of Proposition 2. If that the proposition is not valid, $\exists v_k$ picked for elimination, there is no edge between its neighbors v_i and v_j. We will prove that this contradicts with the assumption based on which v_k is selected.

Since there is no edge between v_i and v_j, then $v_i \prec v_j$ or $v_i \prec v_j$. Assume that $v_i \prec v_j$. Based on the assumption on which v_k is chosen, v_k has no more neighbors than v_i. Meanwhile, v_j is a neighbor of v_k but not of v_i, so $\exists v_t$, which is a neighbor of v_i but not of v_k. Again, based on the assumption on which v_k is chosen, $v_k \prec v_t$.

Now consider the four vertices v_k v_i v_j v_t: if v_t and v_j are connected, the four vertices form a circle in G', in contradict with the fact that G' is triangulated. If v_t and v_j are not connected, $v_t \prec v_j$ or $v_j \prec v_t$. Consider the first case, we have $v_k \prec v_t$, $v_t \prec v_j \Rightarrow v_k \prec v_j$, in contradict with that v_j is v_k's neighbor. Likewise consider the latter case $v_j \prec v_t$, we have $v_i \prec v_j$, $v_j \prec v_t \Rightarrow v_i \prec v_t$, in contradict with that v_i and v_t are connected.

Similarly, the assumption that Proposition 2 is not valid would fail assuming $v_j \prec v_i$.

□

Proposition 2 guarantees that computational cost of variable elimination is bounded by largest clique size of the triangulated graph G'.

B. More Edge Selection Results (Fig 13)

C. More Application Results

C.1. Edge Snapping (Fig 10)

C.2. Saliency Sharpening (Fig 11)

C.3. Image Stylization (Fig 12)

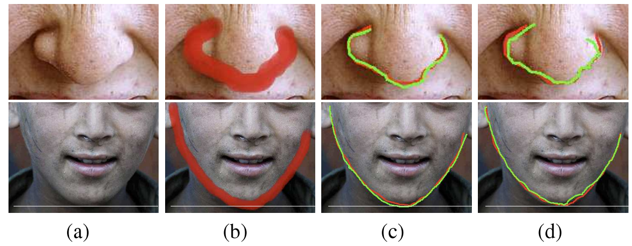


Figure 10. More edge snapping results. (a) input image; (b) user scribble overlayed; (c) our edge snapping results (red is the initial curve, and green is the output); (d) edge snapping results using active contour.

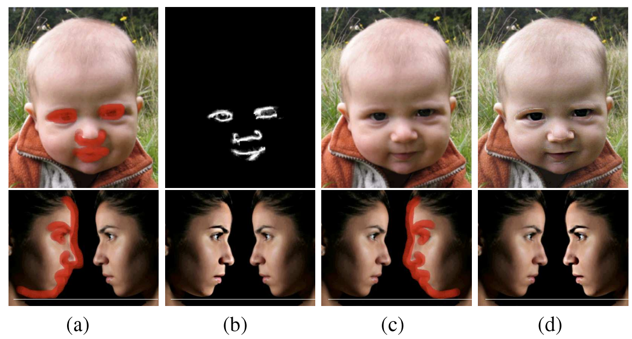


Figure 11. More saliency sharpening results. First line: (a) input image with user scribble overlayed; (b) gradients selected by our approach; (c) results of locally filtering of the selected gradients (our approach); (d) global filtering result. Second line: we show two sets of user scribbles and their corresponding results.

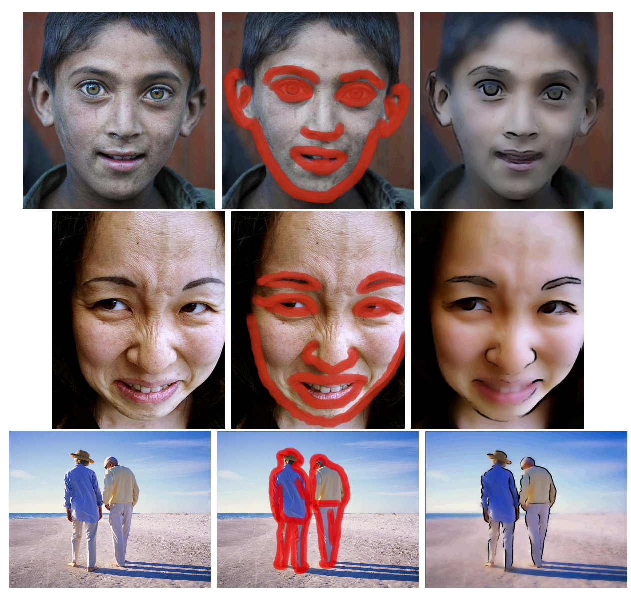
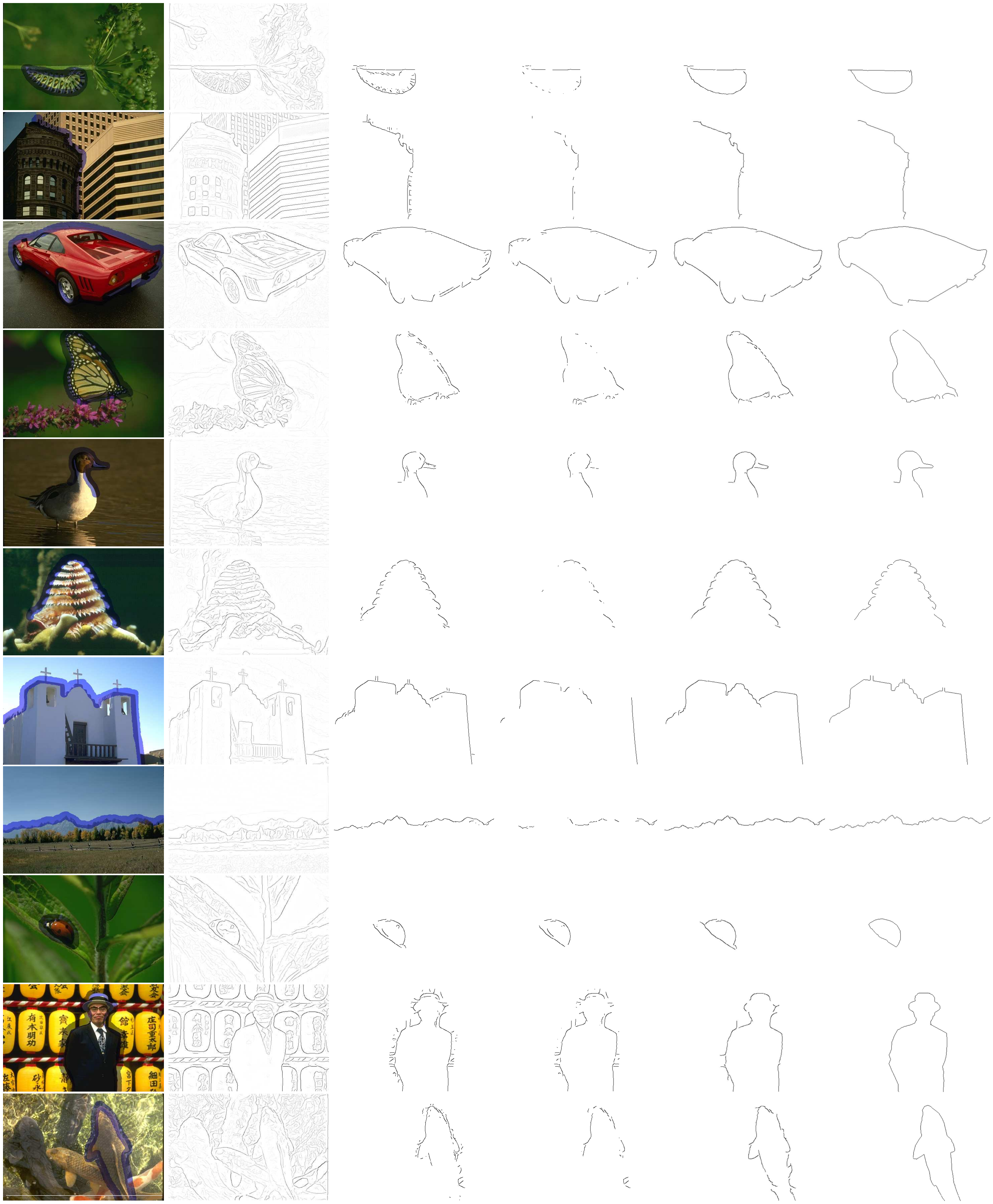


Figure 12. More stylization results. From left to right: input image; user scribbles; our result using gradient selection.



(a) (b) (c) (d) (e) (f)

Figure 13. More edge selection results compared with gPb thresholded by different values. (a) is the original image with an overlay of user scribble; (b) is the edge probability map extracted by gPb; (c) and (d) are the results of directly using the output of gPb within the mask region, using different thresholds; (e) is the output of our method; (f) is the groundtruth.