Exploiting Protrusion Cues for Fast and Effective Shape Modeling via Ellipses SUPPLEMENTARY MATERIALS

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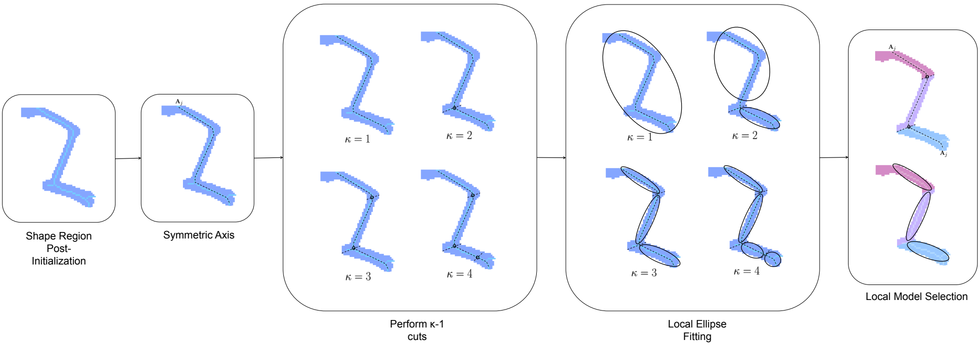

Figure 1: Examples of the local ellipse fitting procedure using $\kappa - 1$ cuts. Given the intermediary results after applying protrusion cues, we first find the symmetric axis $\mathbf{A}_j$. We then perform $\kappa - 1$ cuts along $\mathbf{A}_j$ to produce κ regions. A candidate ellipse model is proposed for each value of κ, which typically ranges from 1 to 5. For each region, the local ellipse model that minimizes Eqn. 2 from the main paper is selected as the representation.

1 Local Ellipse Fitting with $\kappa - 1$ cuts

In the main paper, we described our local ellipse fitting method that performs $\kappa - 1$ cuts along the symmetric axis of a region to produce κ subregions, to each of which we fit an ellipse. We first find the longest continuous segment through the major axis of the region and denote it as the symmetric axis $\mathbf{A}_j$. Next, we initialize κ to 1. The first iteration is, therefore, simply fitting a single ellipse over the entire region. We then increase κ by 1 on each subsequent iteration to make $\kappa - 1$ cuts along the $\mathbf{A}_j$. We compute the inner angle (Eqn. 3 from the main paper) formed at each point $a_o \in \mathbf{A}_j$ using the vectors $\vec{a_{po}}$ and $\vec{a_{qo}}$ where a_p and a_q are located w pixels away on either side of a_o. We form cuts along $\mathbf{A}_j$ at locations where the inner angle is the sharpest (e.g. the value is smallest), resulting in κ regions. We perform local ellipse fitting via a least-square estimator to generate a set of candidate ellipses to represent the regions. The procedure terminates when any of the ellipses falls outside of the image domain or when the least-square fitting fails due to matrix inversion. We then compute the ellipse fitting cost (Eqn. 2 from the main paper) for each set of candidate ellipses and select the model that minimizes the cost. This procedure is illustrated in Fig. 1.

References

[1] Costas Panagiotakis and Antonis Argyros. Parameter-free modelling of 2d shapes with ellipses. *Pattern Recognition*, 2015.

[2] Da Xu, Richard Yi, and Michael Kemp. Fitting multiple connected ellipses to an image silhouette hierarchically. *Image Processing, IEEE Transactions on*, 19(7):1673–1682, 2010.