A COMPETITION-BASED DEFORMABLE TEMPLATE FOR JUNCTION EXTRACTION

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Abstract

We propose a deformable template for junction extraction. Our method evolves from the Kona approach. Junction detection is performed in two steps: center detection and wedge extraction. In the first stage, a local filter is used to detect candidates. Then a template deformation method is used to find the optimal number of sections. **Keywords:** Junction Extraction, Deformable Templates, Energy Minimization, Region Competition.

1 Introduction

The use of junctions as the atoms of more complex processes – depth estimation, matching, and so on – provides useful local information about geometric properties. Hence, methods for extracting these low-level features from real-world images must be efficient and reliable.

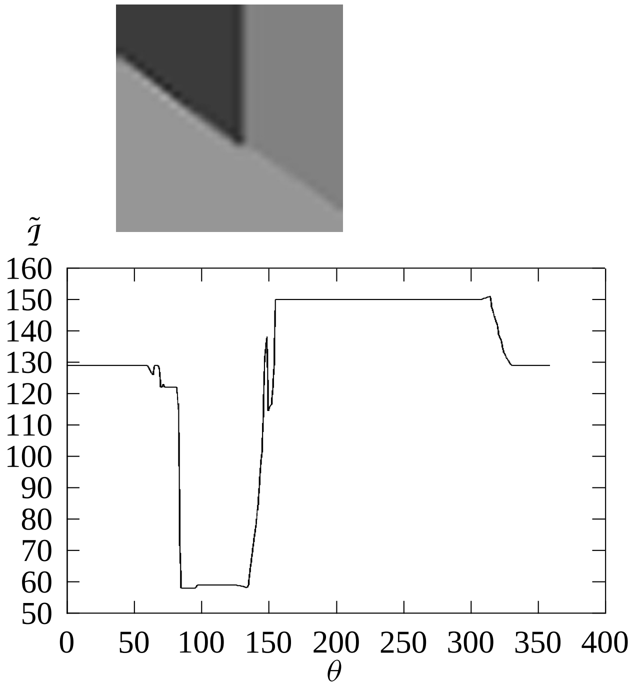

Figure 1: Example of a junction (up) and its intensity profile (down).

2 Region Competition

Applying the Region Competition framework [3] to the intensity profile, the likelihood of a configuration Θ is quantified by the following energy function:

$$\mathcal{E}(\mathcal{I}, \Theta, \{\mu_\mathrm{i}, \sigma_\mathrm{i}\}) = \sum_{i=1}^{N} \left\{ -\log P(\{\tilde{\mathcal{I}}_\theta \in S_\mathrm{i}\}|\alpha_\mathrm{i}) \right\} \quad (1)$$

where: N is the number of angular sections, $P(\{\tilde{\mathcal{I}}_\theta : \theta \in S_\mathrm{i}\}|\alpha_\mathrm{i})$ is the sum of the cost of coding each value $\tilde{\mathcal{I}}_\theta$ within the angular section S_i according to a distribution $P(\tilde{\mathcal{I}}_\theta|\alpha_\mathrm{i})$, and the θ_{S_i} are the limits of the angular sections. Assuming independent probability models for each wedge, we have:

$$\log P(\{\tilde{\mathcal{I}}_\theta \in S_\mathrm{i}\}|\alpha_\mathrm{i}) = \int_{S_\mathrm{i}} \log P(\tilde{\mathcal{I}}_\theta|\alpha_\mathrm{i}) d\theta \quad (2)$$

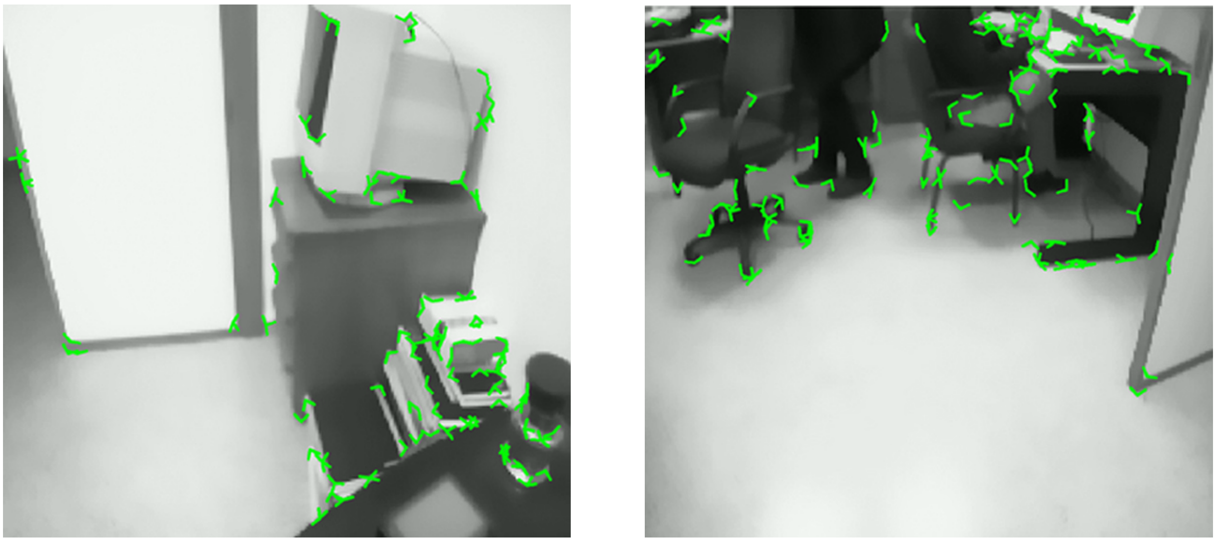

Figure 2: Results in real images.

and the global energy function is (if $i = N$ then $S_{i+1} = S_1$):

$$\mathcal{E}(\mathcal{I}, \Theta, \{\alpha_i\}) = \sum_{i=1}^{N} - \int_{\theta_{S_i}}^{\theta_{S_{i+1}}} \log P(\tilde{\mathcal{I}}_\theta | \alpha_i) d\theta \quad (3)$$

Then, the global likelihood is given by

$$P(\mathcal{I}|\Theta) = \exp\{-\mathcal{E}(\mathcal{I}, \Theta, \{\alpha_i\})\} \quad (4)$$

3 Junction Detection by Energy Minimization

Center detection is done by SUSAN, a robust and fast non-linear filter that has been recently proposed [2].

Once the junction center is estimated, wedge identification is performed by a greedy algorithm, that minimizes $\mathcal{E}(\Theta, \{\mu_i, \sigma_i\})$, considering the basic constraints. We compute initial guesses for each angular section.

Then, we calculate the μ_i, σ_i values of each angular section, and perform steepest descent with respect to the limits θ_{S_i}. For each limit θ_{S_i} we have (see [3] for details):

$$\frac{d\theta_{S_i}}{dt} = \log \left\{ \frac{P(\tilde{\mathcal{I}}_{\theta_{S_i}} | \mu_{i-1}, \sigma_{i-1})}{P(\tilde{\mathcal{I}}_{\theta_{S_i}} | \mu_i, \sigma_i)} \right\} \quad (5)$$

If $P(\tilde{\mathcal{I}}_{\theta_{S_i}} | \mu_i, \sigma_i) > P(\tilde{\mathcal{I}}_{\theta_{S_i}} | \mu_{i-1}, \sigma_{i-1})$, i.e., the point brightness fits better to the distribution of the angular section S_i than to that of angular section S_{i-1}, then the limit of the angular section is moved decreasing its angular value.

4 Conclusions

In this paper we have applied the Region Competition framework to classify junctions in the image. This method allows us to find these features in real time. Our future work in this area includes both the extraction of statistic information about *cornerness*, and the incorporation of a edge support term.

References

[1] L. Parida, D. Geiger, and R. Hummel "Junctions: Detection, Classification, and Reconstr

[2] S. M. Smith and J. M. Brady "SUSAN= A New Approach to Low Level Image Processing" Int. J. Comp. Vision (1997) vol. 23 n. 1 pp. 45-78

[3] S.C. Zhu and A. Yuille "Region Competition = Unifying Snakes, Region Growing, and Bayes/MDL for Multiband Image Segmentation" IEEE Transactions on Pattern Analysis and Machine Intelligence (1996) vol. 18 n. 9 pp. 884-900