Morphology-Based Hierarchical Representation with Application to Text Segmentation in Natural Images

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At a Glance

Problem statement:
- Many text segmentation methods are too elaborate for real-time implementation.

Why our approach is interesting:
- Simple morphological Laplacian but state-of-the-art results.
- Linear time complexity.

Conclusion: our solution achieves
- A new hierarchical representation of images.
- A good trade-off between efficiency and quality.
- A robust method w.r.t contrast changes.
- A solution taking advantage of mathematical morphology.

Background

Morphological Laplacian operator: \( \Delta \mathcal{V} = (\delta \mathcal{V} - \text{id}) - (\text{id} - \varepsilon \mathcal{V}) \)

(a) Input u.
(b) \( \Delta \mathcal{O}(u) > 0 \).
(c) Log(u) > 0.
(d) \( \Delta \mathcal{S}(u) = 0 \).

Tree of Shapes: a representation of the image contents by inclusion [1]

(a) A simple image.
(f) Its tree of shapes.

Some results

Results using “ICDAR 2015 Robust Reading Competition” Challenge 2 DB.

Proposed solution

Input
Laplacian
Gradient

Step 1
Step 2
Step 3

Step 4

Text boxes

Proposed pipeline:

- Step 1: Convert to gray level;
- Step 2: Compute the morphological laplacian and gradient;
- Step 3: Label regions delimited by the 0-crossings and obtain the tree of shapes;
- Step 4: Group components together to form text boxes.

Quantitative results

<table>
<thead>
<tr>
<th>Method</th>
<th>Recall</th>
<th>Precision</th>
<th>F-score</th>
<th>Consistency</th>
</tr>
</thead>
<tbody>
<tr>
<td>SWT [3]</td>
<td>0.864192</td>
<td>0.9861</td>
<td>0.09232</td>
<td>0.505042</td>
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<td>ER [4]</td>
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<td>TMMS [5]</td>
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<td>0.8756528</td>
<td>0.849754</td>
</tr>
</tbody>
</table>

Text segmentation comparison

Evaluation based on coverage and accuracy [2].

Selected Bibliography