MACHINE VISION ON CADASTER PLANS

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Context
Cadaster : set of documents combining cadastral plans and registers.
- Ancient cadasters are one of the richest source documents;
- They depict the story of cities and the changes experienced over time;
- They inform on the social and economic background of inhabitants.

Motivation
- Cadastral plans contain dense information;
- Manual processing of the plans is long and tedious;
- Solution : automatize the extraction of parcels and the recognition of their identifiers to ease and scale up the processing.

Method

1. Preprocessing
- Non-local means denoising to preserve details
- Ridge detection with ‘vesselness measure’ (second order tubular structures) [1]

2. Segmentation
- Oversegmentation using SLIC superpixels [2]
- Graph initialisation with superpixels as vertices
- Merging of similar vertices by minimising intragroup dissimilarity

3. Region classification
- Region classification in 3 classes : text, delimitation lines (contours) and background using SVM classifier

4. Parcel extraction
- Flooding (flood fill algorithm) on regions labelled as background
- Polygon approximation and export of corner point
- Graph initialisation with vesselness
- Merging of similar vertices by minimising
- Polygon approximation and export of corner point

5. Digit extraction
- Localisation of numbers with bounding boxes based on regions classified as text
- Grouping of digit boxes and removal of non-digit boxes
- Correction of number’s orientation using PCA

6. Digit recognition
- Segmentation of the numbers into separated digits
- CNN trained on MNIST database and fine-tuned with digit samples from the register [3]

Results

<table>
<thead>
<tr>
<th>Method</th>
<th>IOU</th>
<th>&gt;0.6</th>
<th>&gt;0.7</th>
<th>&gt;0.8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recall</td>
<td>0.77</td>
<td>0.76</td>
<td>0.72</td>
<td></td>
</tr>
<tr>
<td>Precision</td>
<td>0.55</td>
<td>0.54</td>
<td>0.51</td>
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</tbody>
</table>

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</tr>
</thead>
<tbody>
<tr>
<td>Recall</td>
<td>0.72</td>
<td>0.69</td>
<td>0.60</td>
<td></td>
</tr>
<tr>
<td>Precision</td>
<td>0.75</td>
<td>0.71</td>
<td>0.62</td>
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</table>

On going work
Current work is focused on improving the digit recognition step using recurrent neural networks, which avoid segmenting the numbers into digits. The idea of a Convolutional Recurrent Neural Network (CRNN) architecture is being explored.

Conclusion
- The proposed approach shows promising results, especially with its efficient parcel segmentation and digit identification.
- The system could be extended and integrated into a user interface to take better advantage from the results, for example by allowing the user to correct or to add information about parcels and digits.
- The export of parcel's geometry into GeoJSON format opens up further perspectives to efficiently georeference ancient maps.

References