Subpixel Classification of anthropogenic features using Deep Learning on Sentinel-2 Data

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Background & Workflow

Motivation
- Constantly changing urban areas.
- Periodical utilization of unmanned aerial vehicles for high resolution images is expensive.
- Increasing availability of satellite images such as Sentinel-2.
- Exploitation of the multispectral information contained in Sentinel-2 images.

Data and Workflow
- Data: Sentinel-2 resampled to 1m spatial resolution
- Features: Buildings, Rivers, Railways and roads.
- The workflow is shown in Fig. 1. In addition, we test the effect of using multitemporal data

Deep Learning models
- DeepLab[1] Model with three channel input (RGB)
- DeepLab with nine channels as input
- A novel late fusion approach based on DeepLab
- U-Net[2] with three channels as input
- U-Net with nine channels as input

Results for our initial area

Initial Dataset

Multitemporal Dataset

Effect of multitemporal data on predictions

<table>
<thead>
<tr>
<th>Method</th>
<th>Overall Accuracy</th>
<th>Buildings</th>
<th>Streets</th>
<th>Railway</th>
<th>River</th>
<th>Background</th>
</tr>
</thead>
<tbody>
<tr>
<td>U-Net 3 channels</td>
<td>88%</td>
<td>87%</td>
<td>81%</td>
<td>77%</td>
<td>82%</td>
<td>86%</td>
</tr>
<tr>
<td>DeepLab 3 channels</td>
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<td>59%</td>
<td>54%</td>
<td>69%</td>
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<td>52%</td>
</tr>
<tr>
<td>DeepLab 9 channels</td>
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<td>60%</td>
<td>59%</td>
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<td>62%</td>
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</tr>
<tr>
<td>U-Net 9 channels</td>
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<td>69%</td>
<td>51%</td>
<td>71%</td>
<td>60%</td>
<td>54%</td>
</tr>
</tbody>
</table>

Table 1. Overall accuracies of models trained on the initial dataset

DeepLab[1] model with three channels (RGB) and nine channels (U-Net[2])

Transferability to a different area

Example: Nine Channel DeepLab

Conclusions
- it is possible to identify features such as Buildings, Rivers, Streets and Railways that are partly represented on a subpixel level in Sentinel-2 using advanced deep-learning approaches
- accuracy, however, is still not enough for monitoring purposes
- using multitemporal data significantly improves the power of generalization of the architectures
- The integration into GIS could help planning an support decision-making

References