**SemARFlow: Injecting Semantics into Unsupervised Optical Flow Estimation for Autonomous Driving**

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**Introduction**

- **Unsupervised optical flow estimation**: poorly constrained (occlusions, motion boundaries, poor texture, illumination change, etc.)
- **Can we inject additional information to help?** Example: semantics and domain knowledge
- **Autonomous driving**: labeling flow is hard, but labeling semantics is feasible (and indeed available)
- **SemARFlow**: add Semantic Segmentation inputs (estimated by trained semantic models) to an unsupervised optical flow network (ARFlow[1])
- Improved performance; sharper edges; better results on vehicles; better generalization ability

**Network Architecture**

Adapted from ARFlow[1]

- +enc: adding semantic encoder
- +up: adding learned upsampler
- +no_sm: turning off smoothness loss

**Code**: https://github.com/duke-vision/semantic-unsup-flow-release

**Demo**

Our method outputs **sharper edges around objects**

1. Estimate flow in the first forward pass
2. Extract vehicles and poles from other random samples
3. Copy and paste vehicles/poles with augmented motions to generate augmented samples and pseudo-labels
4. Estimate flow for the augmented samples in the second forward pass, self-supervised by pseudo-labels

**Evaluation**

We greatly outperform state-of-the-arts on KITTI [2]

<table>
<thead>
<tr>
<th>Method</th>
<th>Train</th>
<th>Test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>EPE</td>
<td>Fl-all</td>
</tr>
<tr>
<td>ARFlow (ours)</td>
<td>13.21</td>
<td>4.08</td>
</tr>
<tr>
<td>Ours (baseline)</td>
<td>12.27</td>
<td>3.81</td>
</tr>
<tr>
<td>Ours (+enc)</td>
<td>11.28</td>
<td>3.33</td>
</tr>
<tr>
<td>Ours (+enc +aug)</td>
<td>10.32</td>
<td>2.64</td>
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</tbody>
</table>

**Generalization**: train on Cityscapes[3], test on KITTI[2]

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