Traffic sign inspection and evaluation is mostly done manually by human inspectors. This process is both inefficient and costly.

To automate this process, time stamped images are collected and traffic signs are detected to be either automatically or manually evaluated. Most current detectors are accurate but computationally expensive. Also, in a sequence of consecutive frames, the detectors cannot report that the bounding boxes belong to the same traffic sign.

We provide a traffic sign tracking system that reduces the number of iterations needed by the detector by exploiting the temporal and spatial information in the consecutive images.

To automate this process, time stamped images are collected and traffic signs are detected to be either automatically or manually evaluated. Most current detectors are accurate but computationally expensive. Also, in a sequence of consecutive frames, the detectors cannot report that the bounding boxes belong to the same traffic sign.

We provide a traffic sign tracking system that reduces the number of iterations needed by the detector by exploiting the temporal and spatial information in the consecutive images.

**Method**

- **Detect the traffic signs**
  - Run the detector

- **Randomly Generate Extra Points**
  - Enough to compute the transformation

- **Estimate The Optical Flow**
  - We use the Lucas-Kanade model to predict the new points

- **Extract Feature Points**
  - (SIFT, SURF, Harris Corner, Minimum Eigenvalue Corner)

- **Compute The Homography**
  - Estimate the traffic sign transformation

- **Predict The New Bounding Boxes**
  - Report the confidence

**Introduction**

Traffic sign inspection and evaluation is mostly done manually by human inspectors. This process is both inefficient and costly.

To automate this process, time stamped images are collected and traffic signs are detected to be either automatically or manually evaluated.

Most current detectors are accurate but computationally expensive. Also, in a sequence of consecutive frames, the detectors cannot report that the bounding boxes belong to the same traffic sign.

We provide a traffic sign tracking system that reduces the number of iterations needed by the detector by exploiting the temporal and spatial information in the consecutive images.

**Results**

<table>
<thead>
<tr>
<th>Video</th>
<th>Min EV (%)</th>
<th>Harris (%)</th>
<th>SIFT (%)</th>
<th>SURF (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>84.72</td>
<td>87.56</td>
<td>90.48</td>
<td>81.64</td>
</tr>
<tr>
<td>2</td>
<td>81.63</td>
<td>85.97</td>
<td>93.02</td>
<td>84.21</td>
</tr>
<tr>
<td>3</td>
<td>88.56</td>
<td>88.98</td>
<td>89.69</td>
<td>87.43</td>
</tr>
<tr>
<td>4</td>
<td>92.05</td>
<td>91.49</td>
<td>92.27</td>
<td>84.12</td>
</tr>
<tr>
<td>5</td>
<td>87.10</td>
<td>86.84</td>
<td>89.25</td>
<td>87.91</td>
</tr>
<tr>
<td>6</td>
<td>91.07</td>
<td>90.57</td>
<td>91.32</td>
<td>87.69</td>
</tr>
<tr>
<td>7</td>
<td>87.14</td>
<td>83.92</td>
<td>88.08</td>
<td>73.91</td>
</tr>
</tbody>
</table>

**Discussion**

- The SIFT feature points perform best in tracking the traffic signs compared to the other features.
- The Tracking system allows to omit the use of the detector in almost half of the frames which results in a more efficient traffic sign detection system.
- The Tracker uses the temporal information to recognize that the traffic sign is the same across multiple frames.
- The dataset that the tracker was tested with is the LISA dataset. The images provided in this set are at least 5 frames apart. Therefore we may assume that the tracker would have a better performance on a full consecutive set of frames.

**Future Work**

- Use the tracker to produce training examples
  - Explore the use of optical flow estimation and object tracking to reduce the false positive rates in the detecting phase thus increasing the accuracy of the system.
  - August the training dataset by adding the tracked traffic signs to the training set to improve the detector’s performance

**Acknowledgements**

- This research was part of the Robotics Institute Summer Scholar Program 2017 in Carnegie Mellon University.
- This research was sponsored by Carnegie Mellon University Qatar.
- Thank you to my mentor Dr. Christoph Mertz and the Navlab team for their support and guidance.