A Public Video Dataset for Road Transportation Applications


1Civil, Geological and Mining Engineering / 2Computer and Software Engineering, Polytechnique Montréal
3Transport and Roads / 4Centre for Mathematical Sciences, Lund University, 5Civil Engineering and Applied Mechanics, McGill University

nicolas.saunier@polymtl.ca, ardo@maths.lth.se, jean-philippe.jodoin@polymtl.ca, Aliaksae.Laureshyn@tft.lth.se, micken@maths.lth.se, Ase.Svensson@tft.lth.se, luis.miranda-moreno@mccil.ca, guillaume-alexandre.bilodeau@polymtl.ca, kaile@maths.lth.se

January 14th, 2014
Paper 14-2379

CONTENTS

- Video sensors have unique advantages: rich spatial data, relatively cheap and easy to install, manual verification. Video data may be automatically processed with computer vision methods.
- Video data can support most transportation applications:
  1. Earlier literature review of 45 traffic research articles: 119 unique indicators to describe road users’ behavior
  2. 86% of the indicators can be calculated from trajectories
  3. 14% describe the road users’ personal characteristics (e.g., age, gender) and actions like head movements, eye contact, etc.
  4. Calibration and validation of microscopic models
  5. Studies of accessibility and livability of public spaces
  6. Surrogate safety analysis
- No dedicated large public dataset of video data for transportation applications (several hours) is available:
  1. Few comparisons of different methods on the same datasets:
  2. Comparisons are made on small public and on non-public datasets that cannot represent a wide variety of conditions
  3. Few guidelines exist to choose, replicate, adapt and apply video analysis. Hence, the general progress in this area is not clearly benchmarked, which limits future progress

VIDEO ANALYSIS TASKS

<table>
<thead>
<tr>
<th>Classification</th>
<th>Counts and Speeds</th>
<th>Tracking</th>
<th>All Road Users</th>
<th>Activity Recognition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increasing complexity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

OBJECTIVES

1. Publish a video dataset for transportation applications, open for further contributions
2. Propose standards for video meta-data and annotations, with tools to use the data
3. Demonstrate sample applications
4. Support a TRB workshop on the “Comparison of Surrogate Measures of Safety Extracted from Video Data” that promotes the habit of comparing methods on common datasets, tasks and metrics
5. Bring together researchers and practitioners from the fields of transportation and computer vision through the dataset and workshop

DATA ORGANIZATION AND TOOLS

- Meta-data: when, where, under which conditions and for what purpose
- Camera calibration to project from image to real world space
- Ground truth (GT) annotation: counts, classes, sequences of positions or bounding boxes, volumes, events, etc.
- Documentation and software (load/save meta-data and GT)

SINGLE CAMERA: MONTREAL DATASET

- Video data from 1+ cameras
- 2 intersections on the major arterial Avenue Sherbrooke with mixed traffic collected in June 2011
- 1000 frames (33 s) containing 21 road users

VIDEO SYNCHRONIZATION FOR THE MULTIPLE CAMERAS

- Open source tools in the “Public Dataset of Traffic Video” (PDTV) project
- File formats: yaml, json and bson read and saved by PDTV

MULTIPLE CAMERAS: MINSK DATASET (LUND)

- 1 intersection in Minsk, Belarus, with mixed traffic collected in June 2010 for 3 months with 4 cameras
- 8 traffic conflicts with annotated trajectories

SAMPLE APPLICATION: ROAD USER TRACKING

- PDTV Performance metrics: the two sets of trajectories (GT and tracker output TO) are matched by considering the amount of overlap at each instant using the Hungarian algorithm. Overlap is measured between the real world ground footprints or image bounding boxes in the camera views.

\[ \text{Overlap} = \frac{|\text{GT} \cap \text{TO}|}{|\text{GT} \cup \text{TO}|} \]

- Single frame detector followed by a Kalman filter and data association (Lund) on Minsk
- Feature-based tracker from Traffic Intelligence (Polytechnique Montreal) on Montreal

ACKNOWLEDGMENTS: M. Brosseau and J.-S. Bourdeau who collected the Montreal data and the borough of Plateau Mont-Royal for the authorization.