Objective

Determine whether video analytics can be used to extract relevant traffic data from existing Maryland Department of Transportation (MDOT-MD) closed circuit television (CCTV) camera systems by:

- Conducting a nationwide survey of U.S. transportation agencies to understand other jurisdictions' experiences with video analytics.
- Developing a real-world testbed of representative video clips from MDOT-MD's CCTV video feeds, and performing a feasibility study to evaluate video analytic vendors' capabilities.

Nationwide Survey

- Online survey: 19 multiple choice, 9 fill-in-the-blank, and 12 free response questions focusing on camera infrastructure, video analytics solutions, experiences with vendors, and future plans.
- Distributed to members of transportation agencies from 49 states.

Agency Usage

- 21 agency responses from 20 states, with 9 indicating that they are currently using video analytics.

Use Cases

- Camera deployment varies significantly (20-400 cameras of various types, frame rates, video encodings, and resolutions).

Camera Characteristics

- Video Analytics Solutions

  - Data Outputs

    - Figure 4: Despite differential implementations, the following data outputs are common to at least 3 agencies: speeds, counts, incidents, violations, and disabled vehicles.

  - Use Cases

    - Figure 5: Each of the 3 video analytics firms described different use cases, which can be broadly categorized as focused on operations or planning.

  - Data Validity

    - Figure 6: Questions of reliability in low or poor visibility conditions.

Survey Summary

- Strong interest in video analytics amongst US transportation agencies (34% of states have agencies using or planning to use).
- General concern about reliability of results, particularly during low-light, poor weather, and high-glare conditions.
- Suitability of existing solutions depends on application (i.e., detecting abnormalities vs. highly-accurate speed/count data).

Maryland Feasibility Study

- Developed representative testbed from 10 MDOT-MD CCTV feeds.
- Invited vendors to demonstrate their capabilities on the test clips.

Testbed

- Includes a variety of scenarios (camera locations/angles, time of day, weather, incidents, traffic, road geometry, camera movement).

Vendor Evaluation

- Shared testbed with 3 interested vendors.
- 2 agreed to participate, 2 declined (testbed did not meet requirements), and 1 stopped communicating upon seeing sample clips.
- Vendors A and B provided short annotated videos visually demonstrating their ability to count vehicles and identify incidents/congestion, and also agreed to extract raw data from one of the testbed videos.

Quantitative Results

- Test clip: 1 hour long, contains snowfall and poor visibility.
- Validation: manual counts and probe speed data.
  - Vendor A: within 15% of manual counts and 4% of probe speeds in the primary direction, but did not extract results for secondary direction.
  - Vendor B: within 5% of manual counts and 7% of probe speeds in the primary direction, and 2% of manual counts and 20% of probe speeds in the secondary direction.

Feasibility Study Summary

- Count/speed accuracy is highly dependent on camera positioning and video quality (from vendor comments and quantitative results).
- Even without proper calibration or ideal conditions, video analytics systems may be useful for detecting anomalies.

Conclusions

- General optimism about the future of video analytics, but current solutions have challenges (positioning, visibility requirements).
- Based on existing MDOT-MD CCTV camera infrastructure, video analytics solutions currently most suitable for:
  - Anomaly detection (e.g., incidents, congestion).
  - Short-term data collection under ideal conditions.

Acknowledgments

The authors gratefully acknowledge MDOT-MD for their support, and thank the survey respondents and vendors for their participation.