Polytechnique Montréal

Lab Work 1

Data Collection

CIV8760E : Transport Data Management

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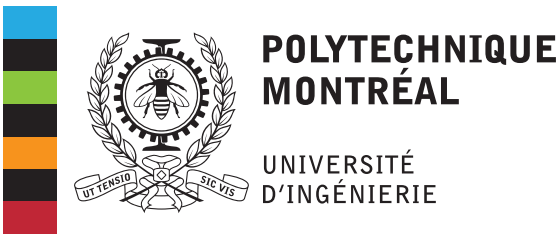

1 Introduction

This assignment focuses on exploring and evaluating different methods for collecting traffic data, specifically monitoring vehicle and bike activities on Saint-Denis Street. The primary goal is to provide hourly counts for bikes, cars, and trucks. In the second part, you will conduct an actual data collection and comparison between manual counting and automated computer vision.

2 Design of a Data Collection Campaign

You are tasked with designing a data collection campaign for monitoring traffic on Saint-Denis Street, between Mont-Royal and Boulevard Crémazie E. The city of Montréal wants to collect both vehicle and bike activities, especially since this section is part of the "Réseau Express Vélo" (REV).

Additionally, the city asked if it was possible to measure the ratio of people wearing helmets.

2.1 Methods for Data Collection

To achieve accurate counts, various methods can be used:

(a) **Physical Detectors:**

- **Inductive Loops:** These are embedded in the road surface and detect changes in inductance caused by the presence of vehicles. They can differentiate between vehicle types based on the change in inductance.
- **Cameras:** Used for visual counting either manually or with computer vision algorithms.
- **Radar Sensors:** Detect vehicles based on the Doppler effect and can provide speed information.
- **Infrared Sensors:** Count vehicles by measuring interruptions in an infrared beam.

(b) **Data Providers:**

- **Global Navigation Satellite System (GNSS):** Provides location-based data but may require integration with other methods for accurate counting.
- **Telecom Data:** Estimations of traffic patterns based on mobile phone signals and location data.

(c) **Simulation-Based:**

- **Traffic Simulation Models:** Use historical data and computational models to predict traffic flow and density. Requires accurate calibration with real-world data.

For each of the listed methods, explain how you can obtain counts by category, with references to existing project in the literature. Try to depict a few options and select the best fitting for this task. Then compare them based on cost, time, precision, availability, and other relevant characteristics, and recommend the most suitable method or a combination for this task.

3 Real-World Data Collection

For this second task, you have been mandated to perform a real world data collection and post-processing. You must count all passing vehicles in a given direction and estimate their speed. You will perform a manual and automatic count, using computer vision, and compare their performances.

3.1 Data Collection Setup

Select a location for data collection, ideally an overpass where you can place a camera aligned as perpendicular to the road as possible. Record at least one hour of footage during rush hour using a video camera on a tripod to minimize movement. If a camera is not available, you can rent one from Polytechnique.

Document the chosen location and the setup process, explaining why this particular site was selected. Ensure your documentation includes details on how the camera was positioned, including frames from the recorded video.

3.2 Data Post-Processing

Once you have the footage, you will develop two post-processing methods to obtain vehicle counts and speeds:

- **Manual Counting:** Count vehicles manually every 5 minutes. Develop a method to estimate vehicle speeds and apply it to at least 12 vehicles.

- **Computer Vision:** Use YOLO (You Only Look Once) to count vehicles and estimate speeds. Create two scripts: one for counting and one for speed estimation, which can be inspired from the Ultralytics guides (Counting , Speed).

Figure 1: Example of camera setup on an overpass

4 Method Comparison

Compare the results from manual counting and computer vision by plotting the number of vehicles recorded against time. Analyze the differences and comment on any discrepancies. Also, plot the speed distribution for both methods—using histograms for computer vision and scatter plots for manual counting.

Discuss which method is more accurate and justify your conclusions. Make suggestions for improvements if needed. Include an analysis of the pros and cons of each method, supported by additional tables or plots if necessary.

5 YOLO Tutorial

This practical work will be conducted over two sessions. The first session will include a YOLO demonstration and task overview. The second session will address technical issues. Therefore, ensure that your video data collection and YOLO setup are completed before the second session on September 20th.

6 Report Submission

Complete the assignment in groups of 2. The report for Task 1 should be concise, limited to 8 pages, focusing on the design and analysis of data collection methods. Task 2, being more technical, does not have a strict length limit but should be clear and focused.

Submit the report in PDF format by October 3rd at 11:59 PM on Moodle. Ensure the report is free from grammatical errors and includes accurate plots and clear explanations. The code must be submitted, either printed in PDF or the .py files. Points will be deducted for errors in writing and inaccuracies in the data analysis. If any Large language model is used (e.g. ChatGPT) you must disclose what you used it for. The grading scale is defined in Table 1.

Table 1: Notation scale

	Task	Points
1	**Design of a data collection campaign**	30
1.1	**Review**	30
	Physical detectors examples	5
	Physical detectors solution	2
	Data provider examples	3
	Data provider solution	2
	Simulation examples	1
	Simulation solution	2
	Helmet ratios feasibility	5
1.2	**Analysis**	10
	Comparison among the methods	5
	Quality and innovativity of the solution	5
2	**Real world collection**	40
2.1	**Set up**	9
	Selection of the site	5
	Respect of footage rules	4
2.2	**Post-processing**	9
	Computer vision method	6
	Speed estimation method	3
2.3	**Analysis**	22
	Plots	3.0
	Highlights of differences	6.0
	Criticism of methods	7.0
	Proposed improvement	6.0
	Total	70