Civil and Environmental Engineering (CEE) 255:
Project #1

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Handed out: 09/02/2022
Due : 09/23/2022 at 9:59am

Collaboration policy: Projects should be done in groups of two or three. Individual projects are exceptions, and as such, will be allowed only in special circumstances. If you feel you should be considered for an individual project, please email the instructors.

Each group must submit their own original paper in bCourses and all written work must be their own. One submission per group is sufficient.

Submission policy: Submission must be done via bCourses.
Each paper must begin with the students names.

Example: Project #1 : firstname1, lastname1 - firstname2, lastname2 - firstname3, lastname3

Each uploaded paper (and code if any) must be named as follows:

- F22-CE255-p1-lastname1-lastname2-lastname3.pdf

IMPORTANT: We will not rerun the codes that you submit. So anything that needs to be considered for grading should be included in the PDF that you upload in bCourses, including figures and results.

Failure to follow these instructions will result in the paper not being graded.

Project

The purpose of this project is to study a freeway section in California and provide a detailed analysis about traffic characteristics that will help manage and operate the system.
The project is divided in three sections and each one must be completed. The first part of the project consists in analyzing the presence of recurrent bottlenecks in a freeway section of your choice. The second part consists in analyzing non-recurrent bottlenecks, the third part consists in analyzing some traffic characteristics.
The data for this project is taken from the Performance Management Systems (PeMS), https://pems.dot.ca.gov/

Task 0: Choose a study section

The goal of this task is to choose a study section and download the relevant data (see appendix).

1. The study section must be chosen such that recurrent and non recurrent bottleneck analysis can be done on the same section. The bottleneck analysis will be performed on a single travel direction for a limited amount of time (am or pm peak hours for recurrent bottlenecks). Guidance for choosing a section: A good section has good detectors, evenly spaced and must show recurrent bottlenecks on normal weekdays (Tuesday, Wednesday and Thursday). The recurrent bottleneck front should be located at the center of the section if possible. The length

of the freeway section and the time period of analysis must be long enough for identifying the generation, propagation and dissipation of the bottleneck (suggested 8-10 miles).
The same section must display at least one or more non recurrent bottlenecks. Hint: you can use PeMS to visualize the relevant data prior to choosing a study section and downloading the data.

Task 1: Recurrent bottleneck analysis

The goal of this task is to recognize and identify a recurrent bottleneck. Those types of bottleneck occur in the same location and time periods of the day. Their behavior and characteristics are reproducible over many days.

1. Bottleneck study. Once the study section is identified, the next goal is to identify the bottleneck, show how it is generated and dissipated and how it evolves in time and space. The study have to address the following:

    - Location and duration of the bottleneck
    - Cause for the creation of the bottleneck
    - Bottleneck impacts on traffic (delay and queues)

Task 2: Non recurring bottleneck analysis

The goal of this task is to recognize and identify a non-recurrent bottleneck. Those types of bottleneck are caused by random events as accidents, breakdowns, weather, etc.

1. Non-recurring bottleneck study. Once the study section is identified, the next goal is to identify the non- recurring bottleneck, show how it is generated and dissipated and how it evolves in time and space. The study have to address the following:

    - Location and duration of the bottleneck
    - Cause for the creation of the bottleneck
    - Bottleneck impacts on traffic (delay and queues), portion of the non-recurrent delay as a function of the total delay.

Task 3: Traffic analysis

The goal of this portion of the project is to analyze traffic conditions and characteristics in the study section selected above. The analysis should be done using PeMS data for the study section chosen for the bottlenecks analysis. It will be performed in a single travel direction for an amount of time of your choice. You must justify the amount of time chosen. Based on the section of your choice and the data available in that section you may choose two topics of your choice

- *Traffic characteristics*: Plot flow vs speed, flow vs. occupancy. Estimate free flow speed, areas of undersaturated, oversaturated and queue discharge flows.

- *Incident impact*: Investigate the incident frequency and characteristics at the study corridor. Derive key statistics and distributions of incident frequency, severity and duration. Estimate total delay and relation with incident frequency.

- *Weather impact*: Investigate key statistics on how weather impacts traffic. Estimate the delay caused by the weather conditions and how they impact the creation of bottlenecks.

- *Travel times*: Estimate the average travel time. Explore how the travel time statistics are affected by the presence and severity of bottleneck(s). Is the travel time measure reliable in the study section?

Report

The report should be self-contained as it is meant to mimic a technical report.
The report should contain:

1. Introduction
2. Problem statement
3. Methodology
4. Results
5. Discussion of the results
6. Conclusion
7. References
8. Appendix (if any)

It is suggested that you use the three week project as follows:

- Week 1: PeMS understanding, study section selection and data download
- Week 2: Recurrent and non-recurrent bottleneck analyisis
- Week 3. Traffic analysis and report writing

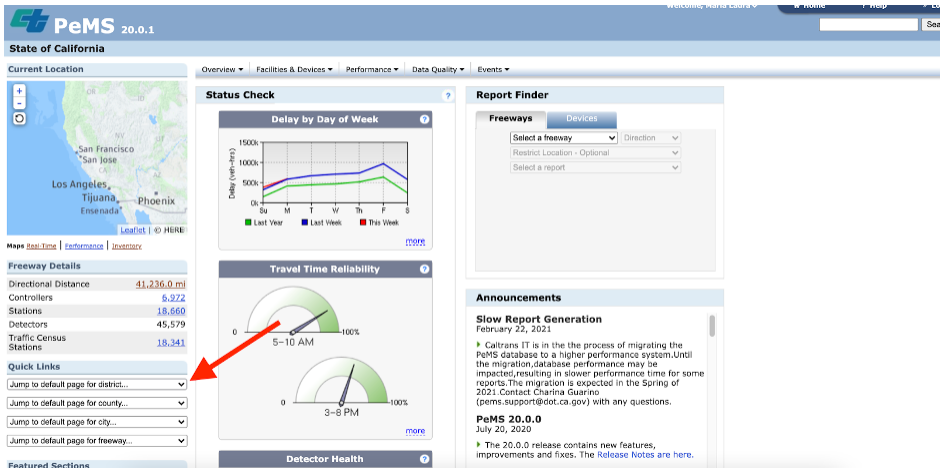
1 Appendix: Downloading the data for the project

This guide will get you started with PeMS but you should explore on your own to take advantage of all the features.

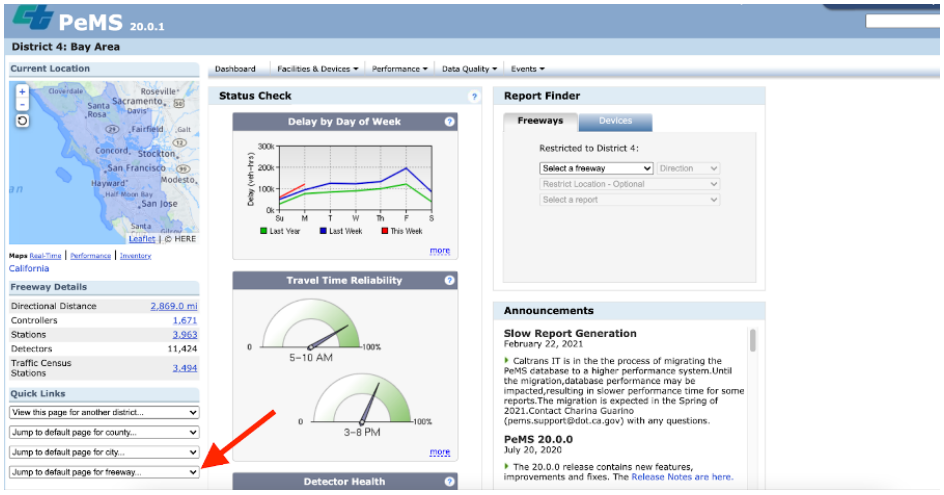
1. Go to https://pems.dot.ca.gov/ and create an account
2. Once your account is approved follow these instructions to download the data

Option 1: 5 minutes detector loops (sufficient for this study)

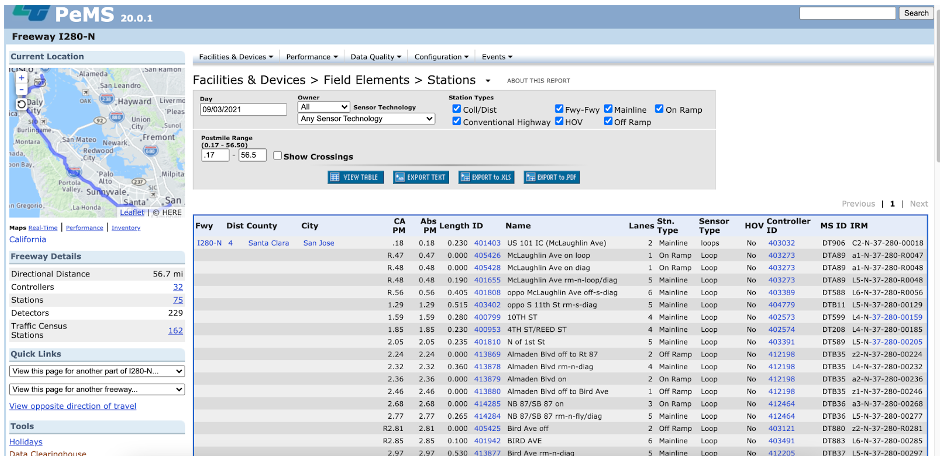
a) On the home page click on "Jump to default page for district" and choose a district



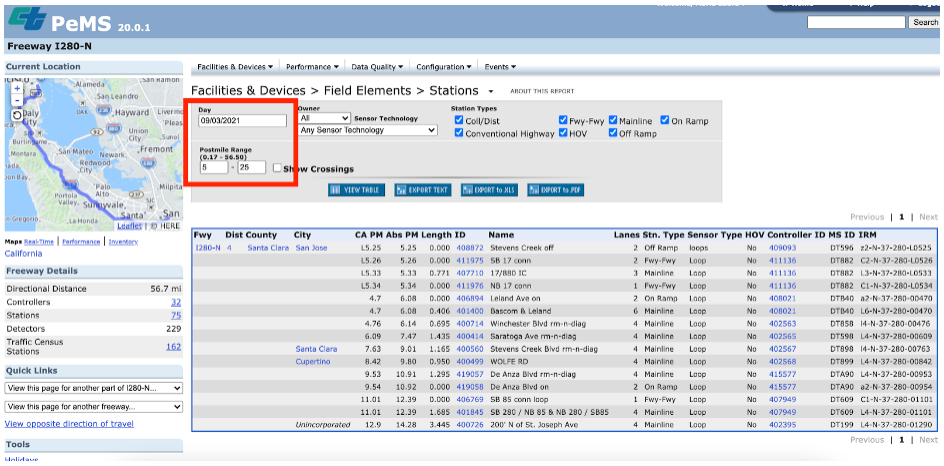
b) Once you choose a district, the page will reload and you can choose a specific freeway in that district in a particular direction



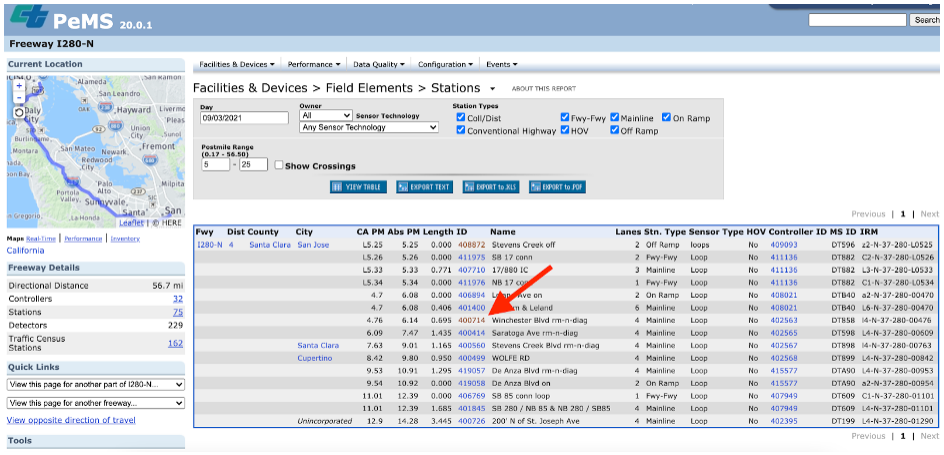
c) Choose your freeway and you will land in the page with all the detectors available in that freeway and direction of travel



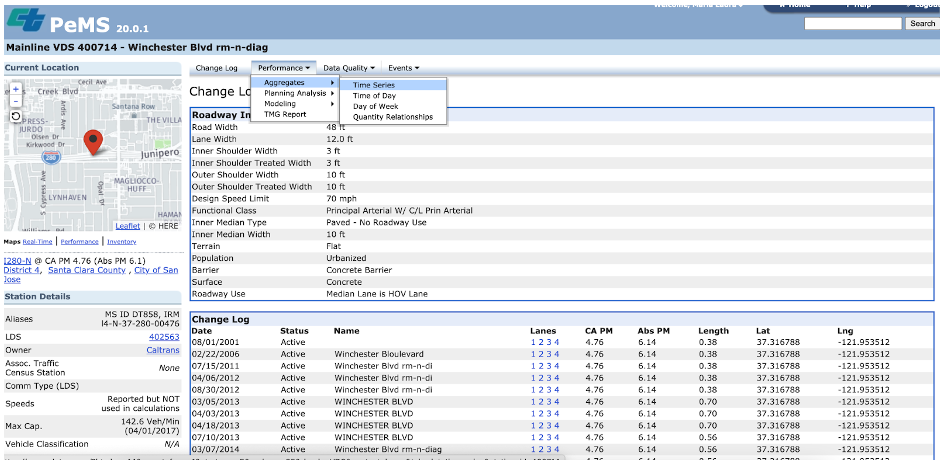
d) Here choose the date and the postmile range to obtain only the detectors for your study section



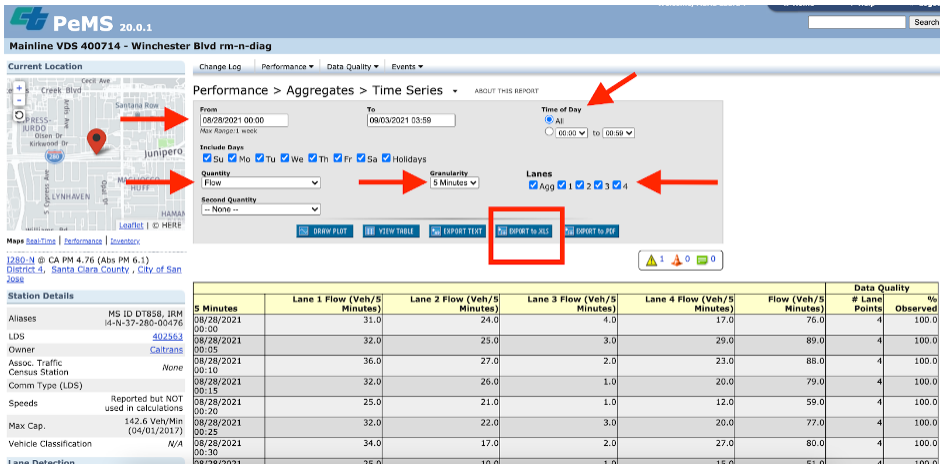
e) Choose the detector and click on it



f) Choose from the window menu Performances → Aggregates → Time series

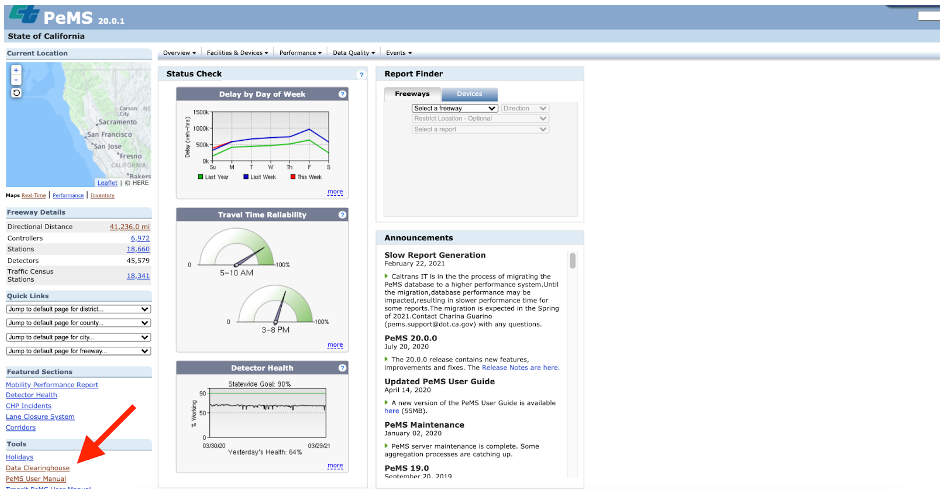


g) Customize your time interval, quantity and lanes. Fix the granularity at 5 minutes and then export your data to .xls



Option 2: Using clearinghouse

a) From the home page, click on Data Clearinghouse



b) Pick the data you want, the district and the date and download .txt files. The field specification will explain the different columns of the .txt that you download. Extract needed data from the downloaded file.