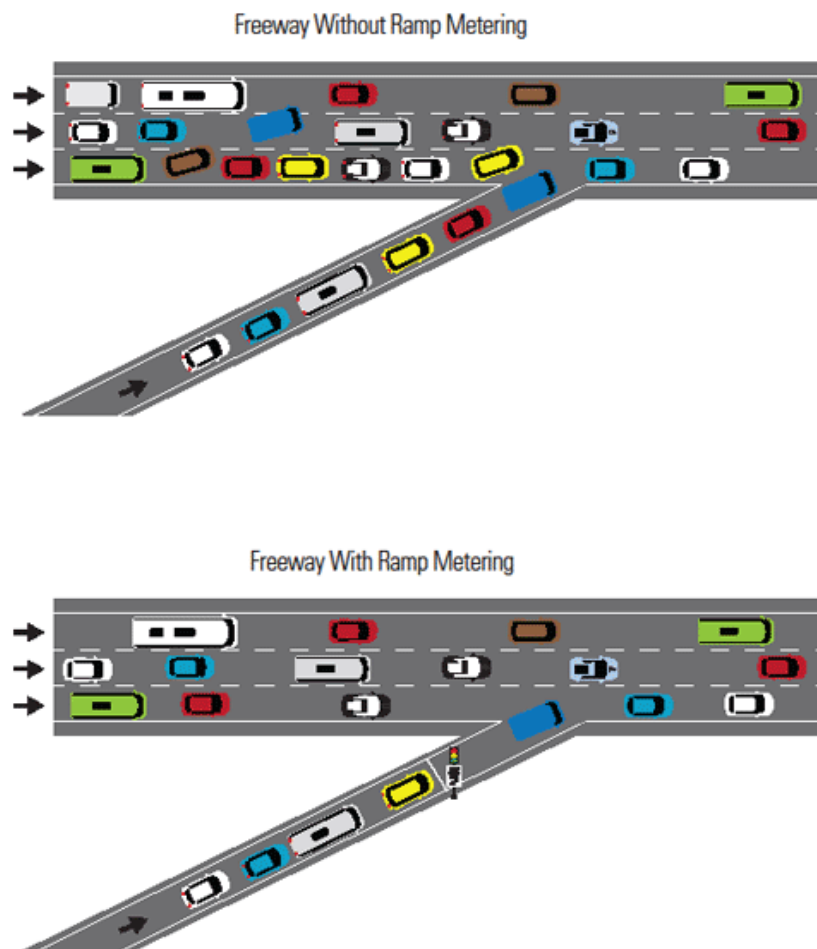


## Reinforcement Learning and Optimal Control – Nadir Farhi

### Project 2024-2025 - Reinforcement learning for ramp metering on highways.

The objective of this project is to apply algorithms of Q-learning and Deep Q-learning to learn by numerical simulation the ramp metering control on a highway. We consider a stretch of highway with a given number of lanes (which is a parameter here), with an entering ramp controlled with a traffic light. We use the traffic simulator SUMO (Simulation of Urban Mobility) to simulate the car-following and lane change of all cars. The Q-learning algorithm should control the traffic light at the ramp, in a way that it optimizes the traffic, both on the highway stretch and on the ramp.



<https://ops.fhwa.dot.gov>

Possibility of using the work of Romain Ducrocq :

- Project 1: Framework DQN: <https://github.com/romainducrocq/frameworkQ/>
- Project 2: DQN for Intelligent Traffic Signal Control with Partial Detection: <https://github.com/romainducrocq/DQN-ITSCwPD/>
- Article sur Arxiv: <https://arxiv.org/abs/2109.14337>

#### State variables :

The state variable representation should reflect the state of traffic on both the highway, and the entering ramp.

#### Action variables :

The action variable can be for example the proportion of the green light in predefined cycle of the traffic light (cyclic control).

**Reward :**

The reward modeling should reflect the optimization of traffic on both the highway and the ramp.

**Scenarios**

Vary the values of the following parameters, in order to cover a maximum number of scenarios

- Length of the highway stretch
- Speed limits on the highway and on the ramp.
- Initial car-density on the highway stretch and on the ramp.
- The car-flow (veh./h.) on the highway, and the inflow from the input ramp.
- Number of lanes
- etc.