# Q-CAR - Dynamic obstacle collision avoidance using DDQN

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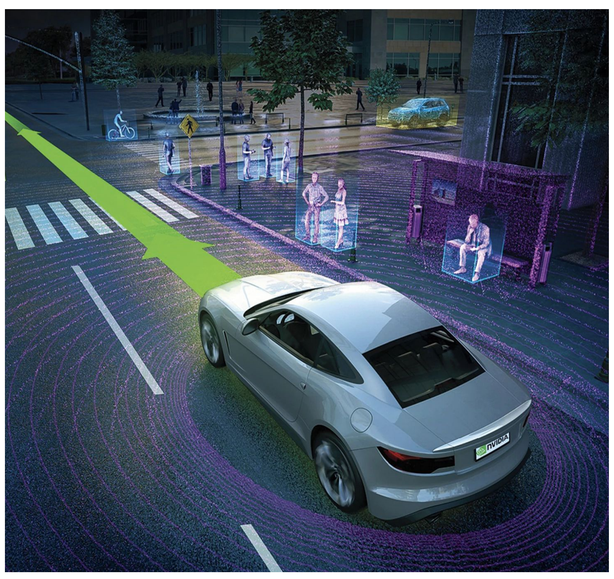
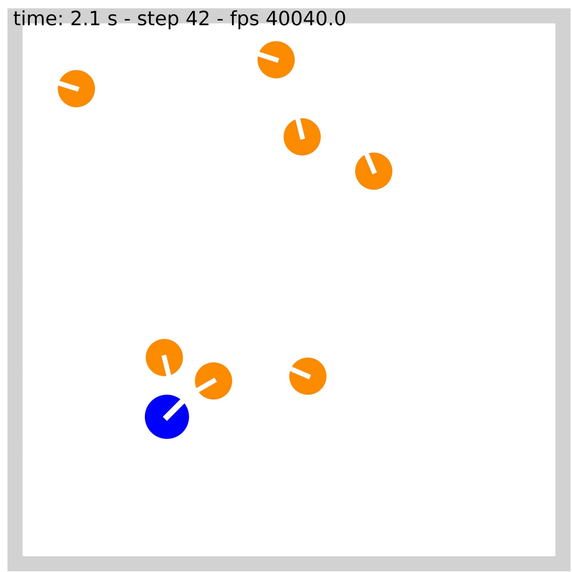
## Project goals

- Agent goal is to avoid collision with dynamic and static obstacles
- Simplified world simulation
- Model free control using reinforcement learning
- Generalization for changing environments

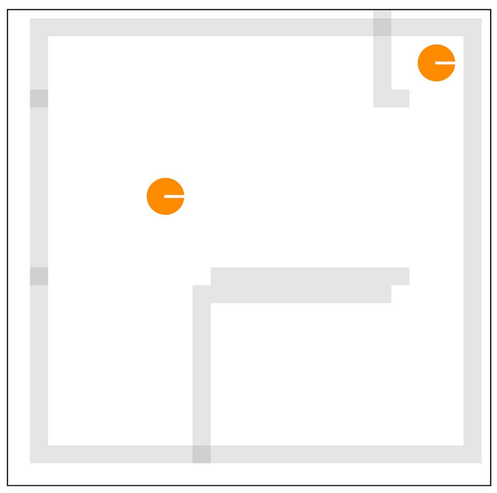


(1)

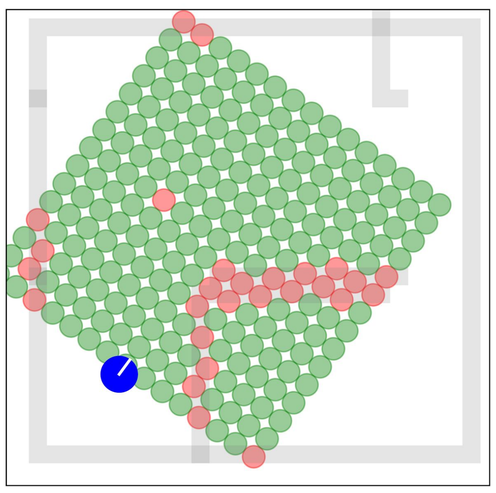



## Input: History of local agent views

- Sampled occupancy grid as agent local view
- History of local views
- Adjustable grid size, length and offset in both axis



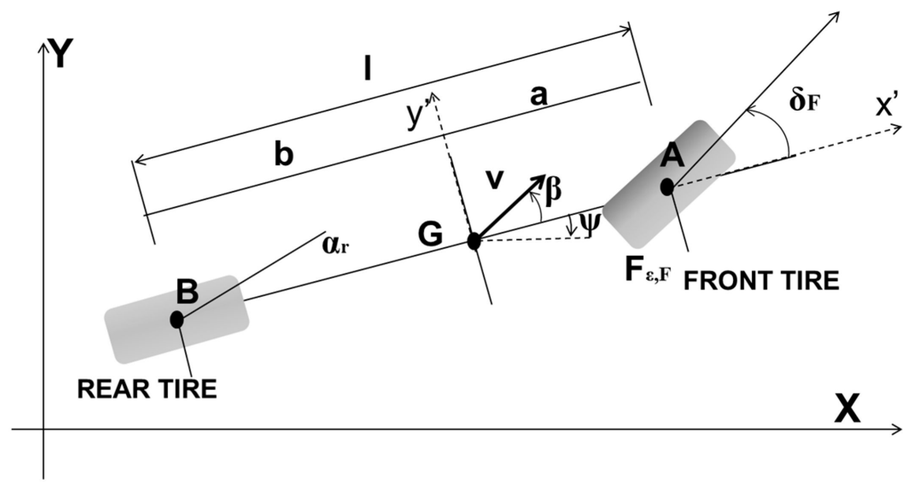
Environment



Agent local view

## Output: Discrete driving commands

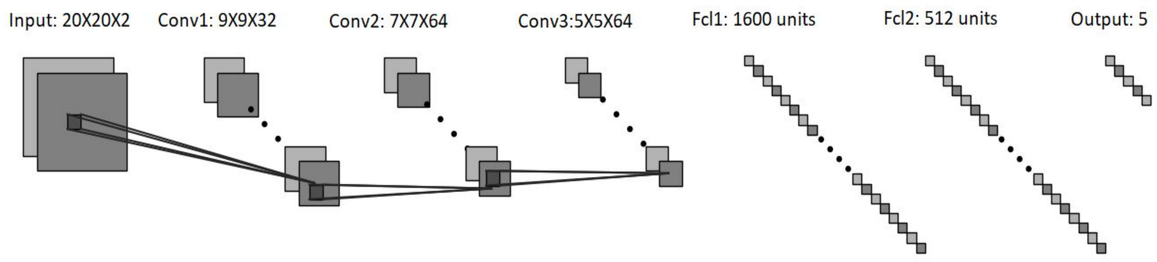
- Agent model based on bicycle kinematics
- Agent can choose from a discrete predefined actions of speed and steering angles




Car dynamics: Bicycle kinematic model (2)

## Training

- Training using a CNN network with DDQN
- Training in a dynamic environment with random moving agents and static walls
- Reward based on distance and collisions

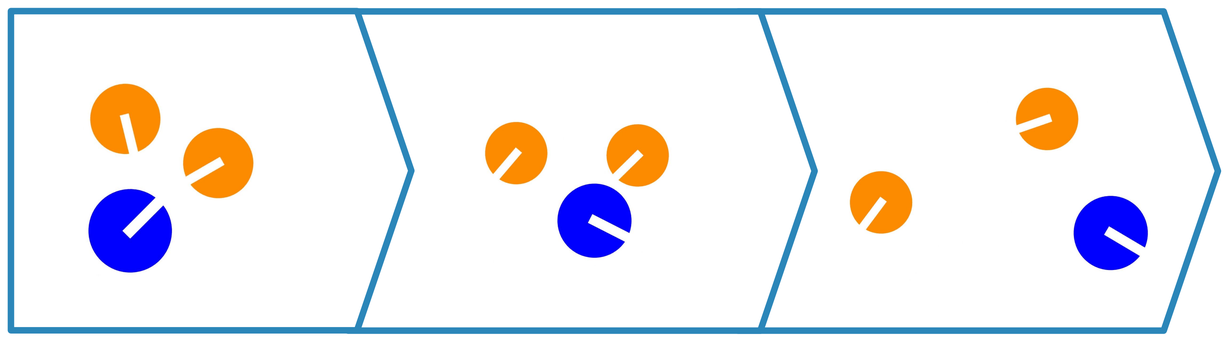



| Layer | No. of filters/Units | Kernel size | Stride | Activation function |
|---|---|---|---|---|
| Convolution 1 | 32 | 2x2 | 2 | Relu |
| Convolution 2 | 64 | 3x3 | 1 | Relu |
| Convolution 3 | 64 | 3x3 | 1 | Relu |
| Fully connected 4 | 512 | | | Relu |
| Fully connected 5 | 5 | | | linear |

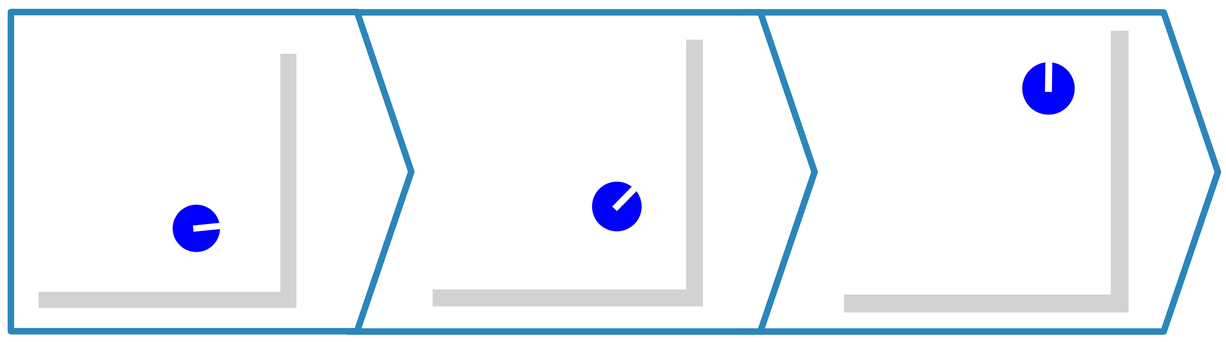
Architecture

## Results

- Agent avoids collision with obstacles
- Generalize to different environments
- Modular architecture



Dynamic agents avoidance



Static wall avoidance

(1) http://www.motortrend.com/news/tapping-the-brakes-why-the-autonomous-car-society-is-still-decades-away-reference-mark/

(2) Zardin B, Borghi M, Gherardini F, Zanasi N. Modelling and Simulation of a Hydrostatic Steering System for Agricultural Tractors. *Energies*. 2018; 11(1):230.