Self driving cars

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Introduction

Problem

Create a system that can drive a car automatically.

Challenges

- Different environments and type of roads;
- Other cars, pedestrians, road markings;
- Different weather conditions and lighting.

Introduction

Solution

Convolutional neural net which will analyze external conditions in real time and control the car accordingly.

Properties

Model will train end to end i.e. no feature engineering is needed.

Bojarski, Mariusz, et al. *End to end learning for self-driving cars.* arXiv preprint arXiv:1604.07316 (2016).

Data collection

Original data

Data is being collected as a video from the windshield camera. Label is the steering angle applied by the human driver.

Issue

The network must learn how to recover from mistakes. Otherwise the car will slowly drift off the road.

Data augmentation

- Images for two specific off-center shifts are obtained from the left and the right camera;
- Additional shifts between the cameras and all rotations are simulated by viewpoint transformation of the image from the nearest camera.

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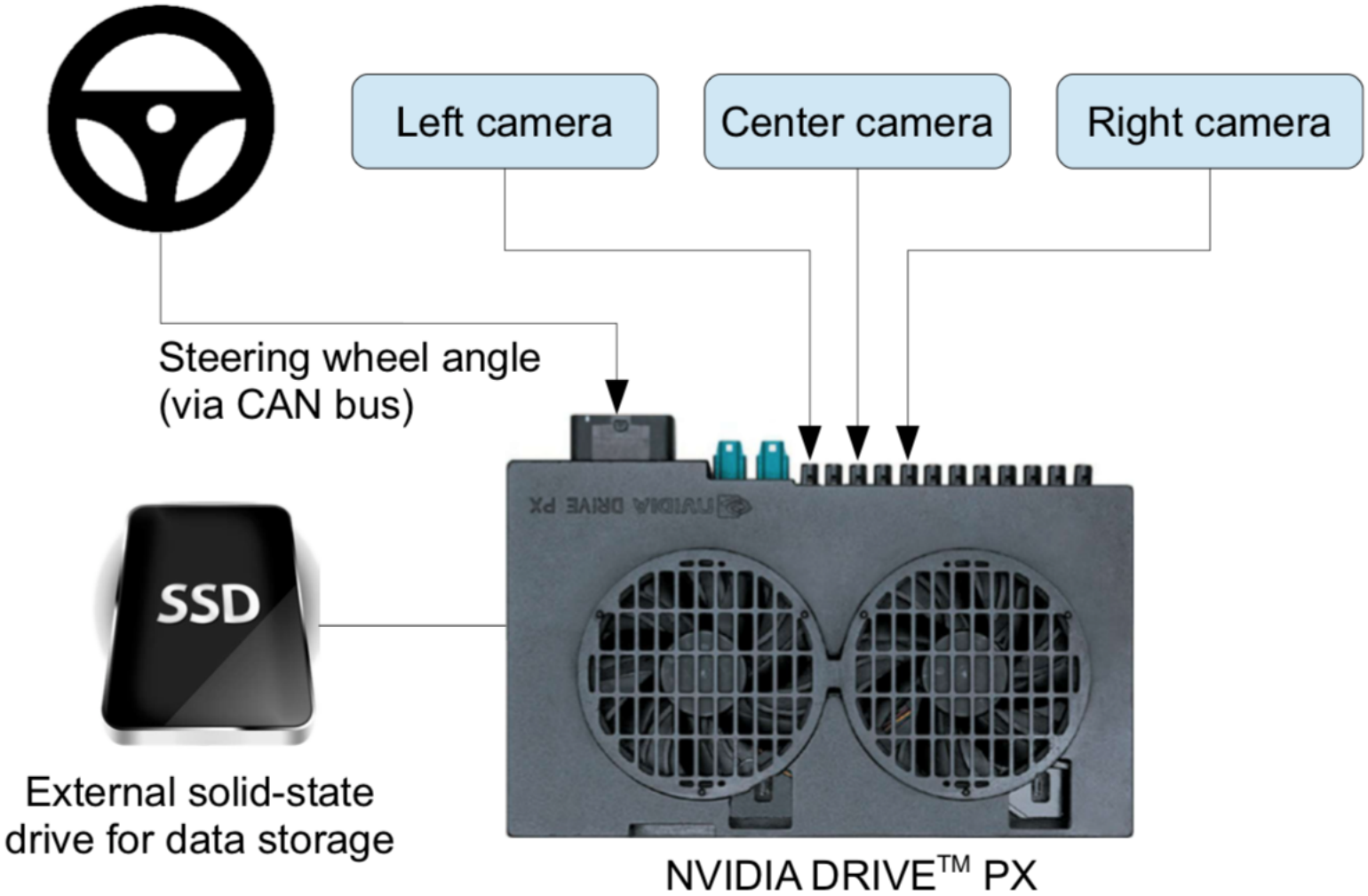
Data collection



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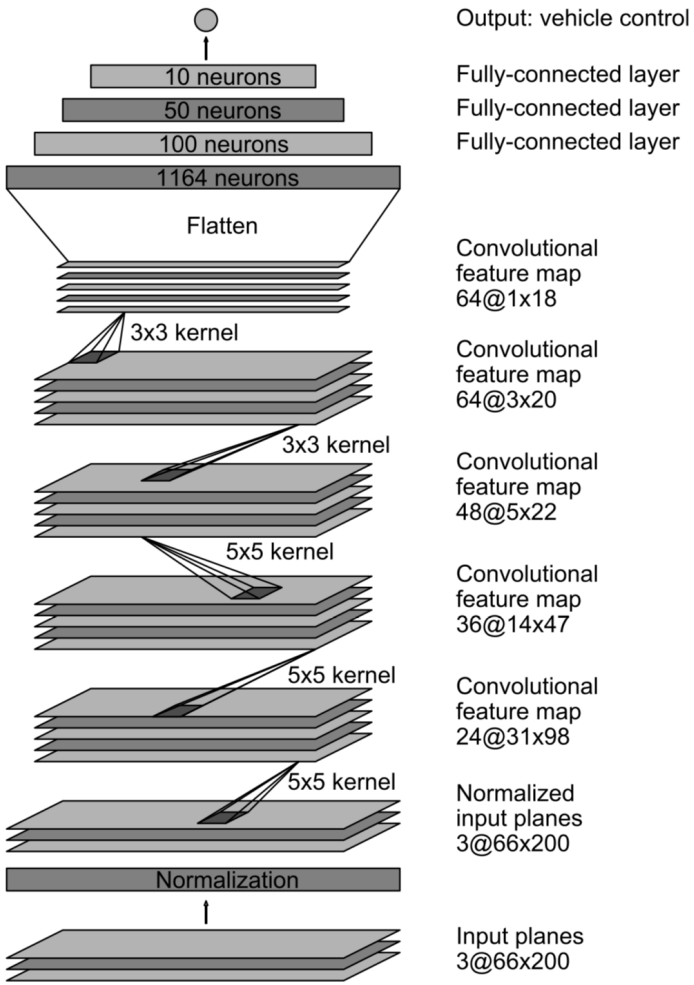
Network architecture



Architecture

We train CNN which has conv layers as a feature extractor and fully connected layers as a controller.

Loss function

The objective is a mean squared error between the steering command output by the network and the command of the human driver.

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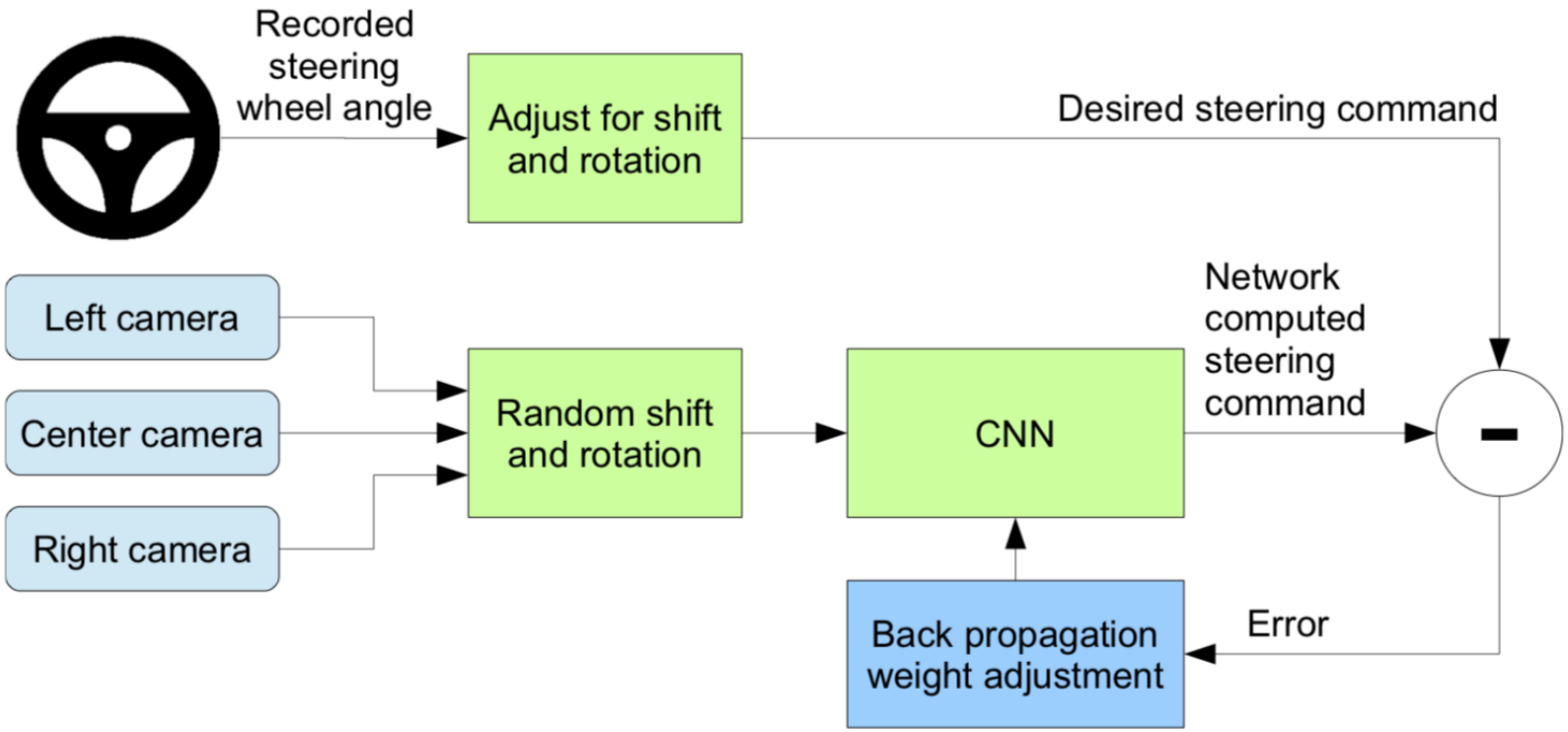
Training



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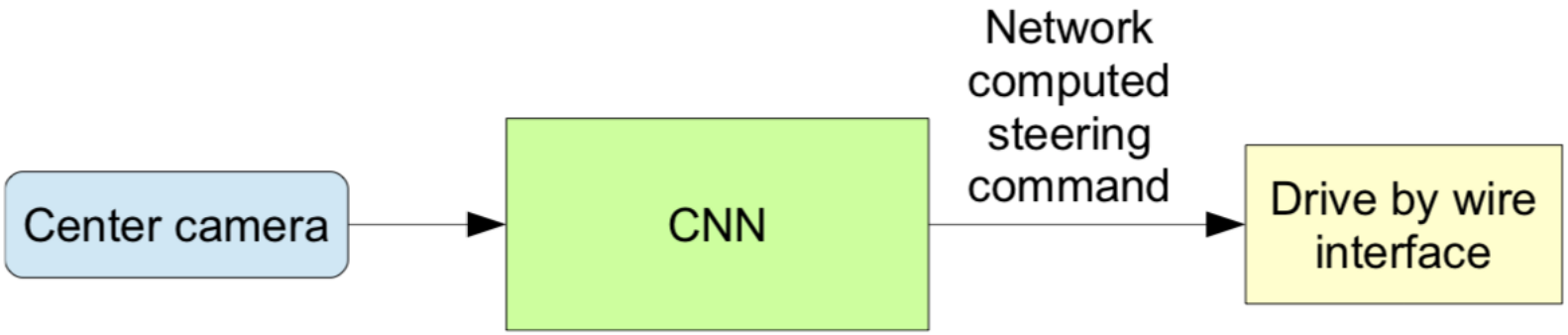
Driving



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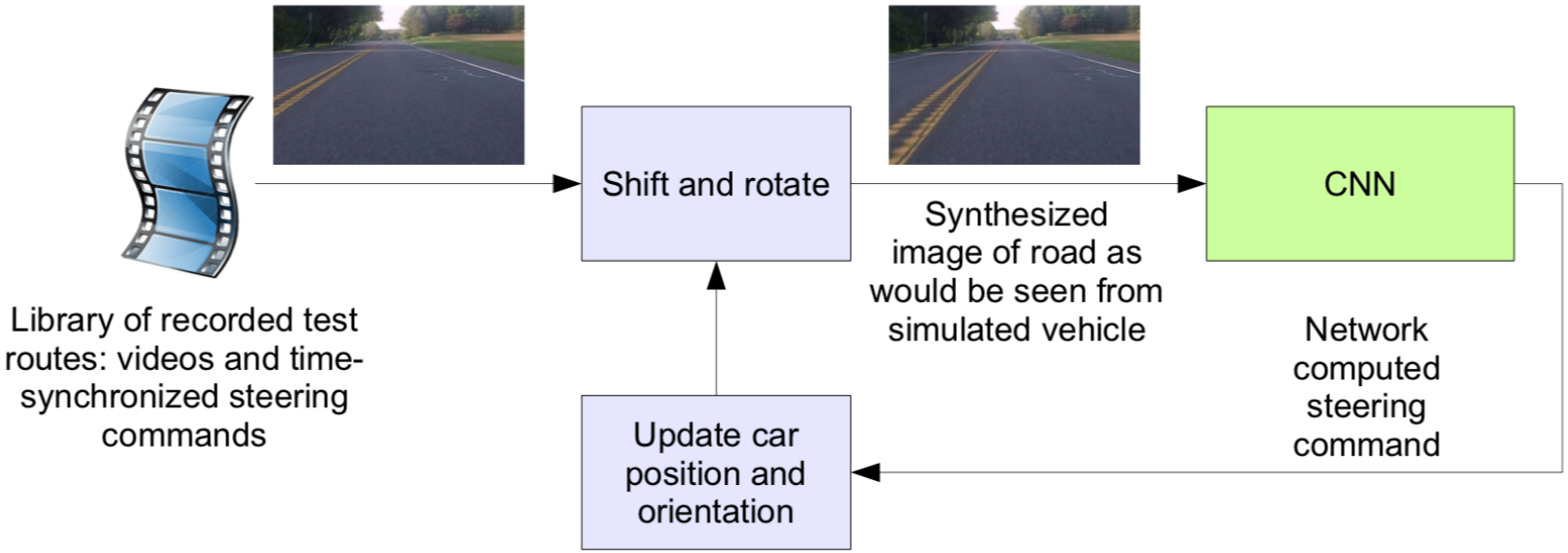
Simulation



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Real driving

Evaluation metric

$$\text{autonomy} = \left(1 - \frac{(\text{number of interventions} \cdot 6)}{\text{elapsed time}}\right) \cdot 100$$

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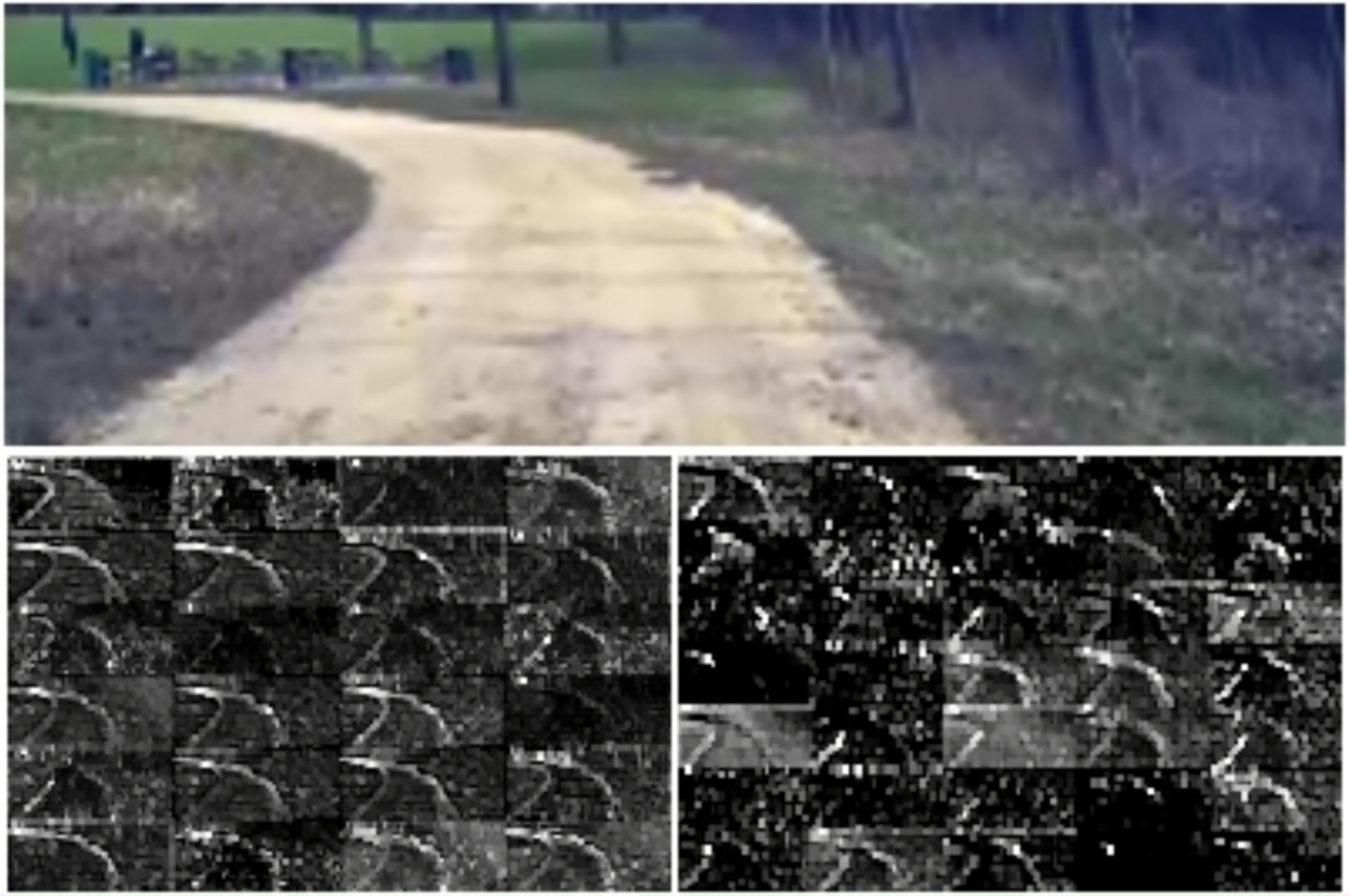
Activations



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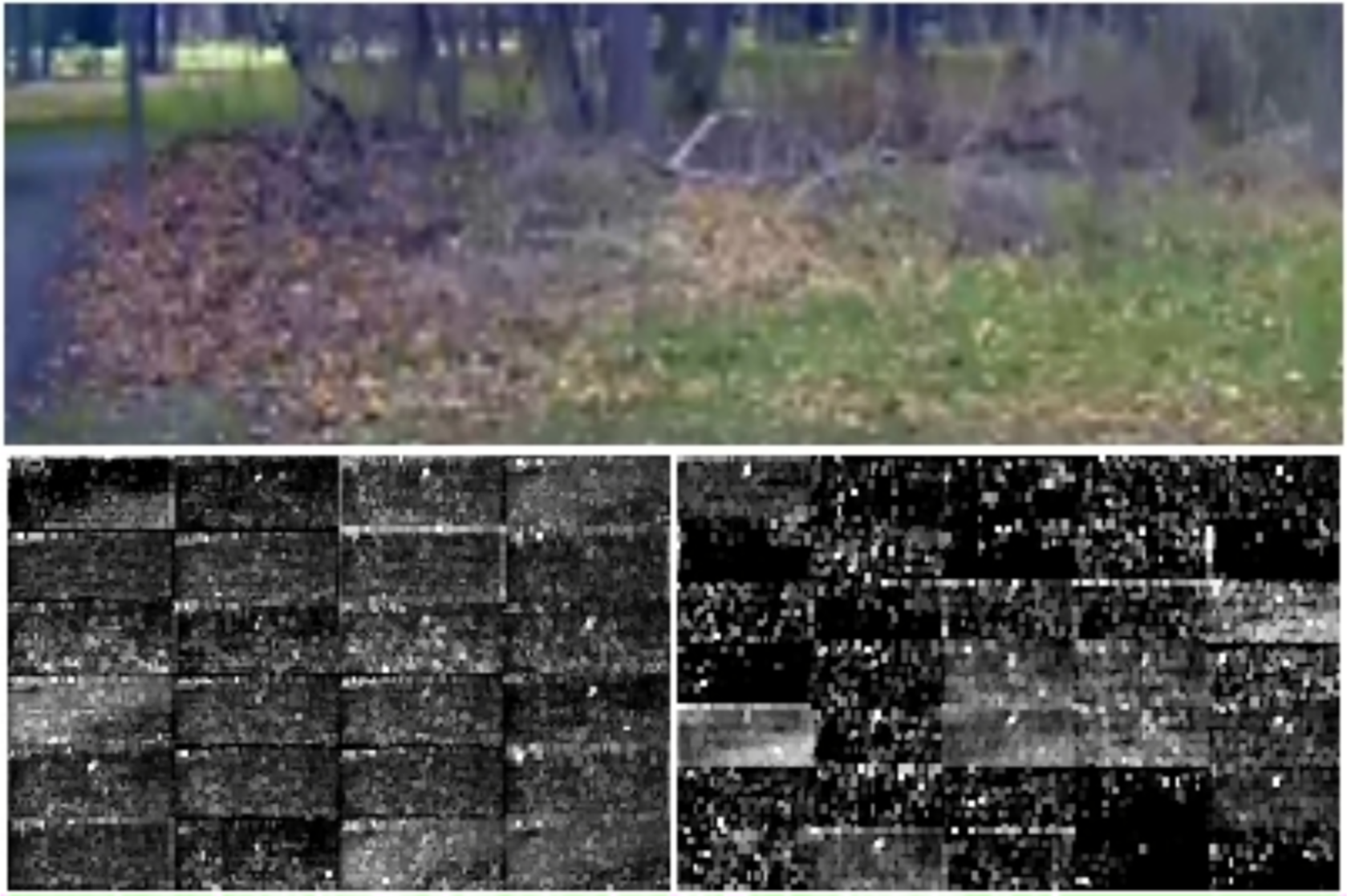
Activations



Bojarski, Mariusz, et al. *End to end learning for self-driving cars.* arXiv preprint arXiv:1604.07316 (2016).

Reference

Bojarski, M., Del Testa, D., Dworakowski, D., Firner, B., Flepp, B., Goyal, P., Jackel, L. D., Monfort, M., Muller, U., Zhang, J., et al. (2016).
End to end learning for self-driving cars.
arXiv preprint arXiv:1604.07316.