RUHR-UNIVERSITÄT BOCHUM

INSTITUT FÜR NEUROINFORMATIK

RUB

Evaluation of Synthetic Video Data in Machine Learning Approaches for Parking Space Classification

Daniela Horn and Sebastian Houben
University of Bochum, Institute for Neural Computation, Germany

Examples of training data extracted from simulated environment footage. Weather and lighting conditions include sunny, cloudy and foggy samples.

Motivation

- Rising demand for annotated data in computer vision and machine learning tasks
- Problematic for new applications and special cases
- Huge effort of gathering data plus manual labeling makes many tasks unfeasible
- Limits scientific progress to a relatively small number of applications

→ Simulated data as an easy and controllable alternative to real-world image data

- But: Is the use of purely synthetic training data sufficient to build a recognition system with comparable performance?

Simulated Data Generation[1]

- Simulated car park environment based on Unreal Engine 4
- Video data gathered from environment with artificial cameras
- Footage covers 5 different weather and lighting scenarios in total
- Exemplary task: parking space classification

Different weather and lighting scenarios within the simulated environment. *Left:* sunshine, *Center:* overcast sky, *Right:* fog

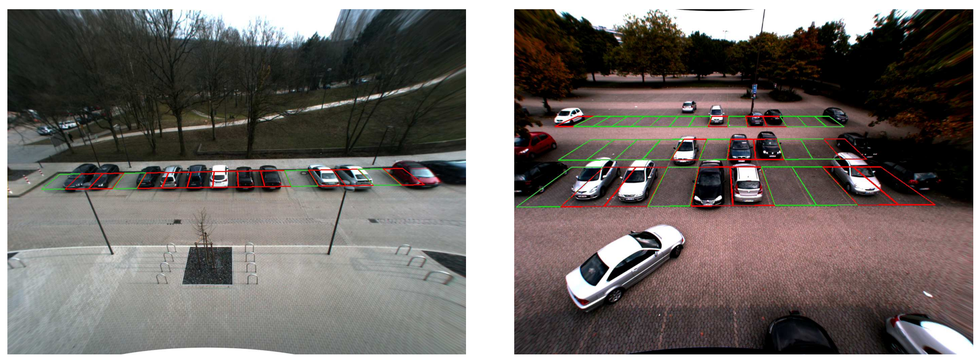
Automatic Data Extraction

- Data extraction on the fly
- Simultaneous extraction of training data and ground-truth labeling
- Training data: image crops of single parking spaces
- Ground truth: unique parking space ID, system time stamp, and occupancy status

Experiments

- Training and evaluation of kNN and SVM classifiers
- DoG features of different filter sizes as input features
- Full replacement of image training data with synthetic images
- Training data comprises 3 different weather/lighting scenarios: sunny, cloudy, foggy
- Evaluation on real-world video sequences of two different car parks
- Measurement of classifier performance for individual parking spaces averaged per row

Sequence A | Sequence B

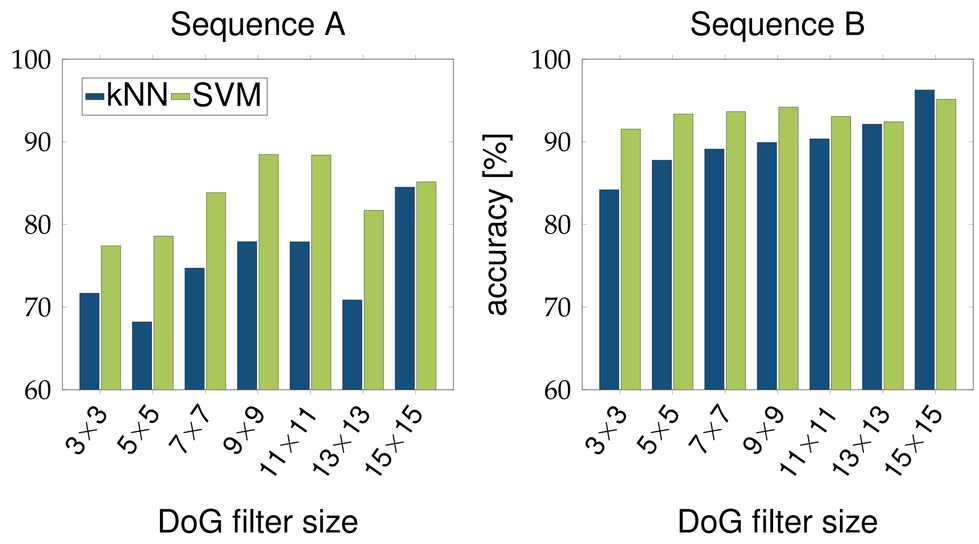


Real-time classification of two different parking areas. Red boxes are identified as occupied, green boxes denote available parking spaces.

Results

- SVM outperforms kNN classifier in most cases
- Classification rate dependent on distance to camera
- Slightly less accurate than previously evaluated classifiers trained on real-world data

→ Parking space classification task can be solved without use of real video data



Outlook

- Create more diverse weather/lighting scenarios and additional parking areas
- Add disruptive elements for more realism, such as wind simulation, camera movement, and pedestrians
- Extend usability of simulated environment to other machine learning tasks, *e.g.* vehicle tracking and orientation classification

→ Ultimately enable new applications for image processing algorithms

[1] M. Tschentscher, B. Pruß, and D. Horn, "A Simulated Car-Park Environment for the Evaluation of Video-Based On-Site Parking Guidance Systems," in *2017 IEEE Intelligent Vehicles Symposium (IV)*, June 2017, pp. 1571–1576.