Elektrotechnisches Kolloquium

der Bergischen Universität Wuppertal

Die Fakultät für Elektrotechnik, Informationstechnik und Medientechnik lädt zur Teilnahme an folgender Vortragsveranstaltung mit anschließender Diskussion ein:

Es spricht

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über das Thema
Radar-based Environment Perception for Automotive Applications

Inhalt:

The last decade has witnessed a growing interest in autonomous driving applications. For this reason, vehicles have been equipped with more and more sensors that enable perception of the surrounding environment. These sensors, however, provide raw data which do not automatically solve the perception tasks. Therefore, it is necessary the application of processing algorithms in order to extract information of interest, like the position of a vehicle or the color of a traffic light. This presentation is intended to provide innovations in the field of environment perception for automotive applications, with specific focus on Deep Learning (DL)/Machine Learning (ML) algorithms and radar data. The first contribution presented concerns the semantic segmentation of automotive radar point clouds. It consists in an architecture based on neural networks (NNs) that evolves the state-of-the-art by addressing intrinsic prop- erties of the radar sensor. The resulting method, called RadarPCNN, proves superior performance on a custom dataset composed on real-world radar reflections. It exploits a pre-processing module to learn insightful object-related signatures from the radar features. Furthermore, it leverages the PointNet++ framework, adopting the mean-shift (MS) algorithm during the sampling stage to optimize usage of the scarce spatial information. Finally, an attention mechanism is designed to merge local information extracted at different stages. All the solutions devised to improve the semantic segmentation performance on radar point clouds are validated and results effective, improving the state-of-the-art performance. The stunning ability of point-wise processing methods to correctly classify object- reflections, notably pedestrians, has fueled the interest for a deeper investigation. Indeed, pedestrians are objects which are very difficult to recognize from radar data, due to their weak signature from the sensor perspective. For this reason, it has been decided to conduct a survey on the usage of radar features for the pedestrian detection task. The characteristics of PointNet++, PointNet and random forest (RF) are evaluated. It is proved that Doppler represents the most informative feature for the task. Moreover, it is shown that PointNet++ has unique usages of the radar features compared with the other approaches. Indeed, it is the only tested method to exploit the spatial point position to infer the pedestrian class prediction. Though semantic segmentation provides details about the objects-distribution in the scene, it does not deliver exhaustive descriptions. For this reason, it has been decided to design a point-wise processing architecture that produce object-estimations from raw radar point clouds. The proposed system optimizes the state-of-the-art radar solution by means of a two-stage procedure. The first stage proposes points as object center-proposals and move them closer to the true center of the respective object. The second stage leverages the outputs of the first stage to estimate the object box-parameters. In particular, it discards the template-based formula- tion from the prior art in favor of a regression-aided one. Furthermore, it adopts a spherical regression task to estimate the box-orientation. Finally, the addition of a confidence output score enables filtering of the box-predictions in a post-processing step. The proposed model is compared with the prior art, proving better detection performance and box-accuracy, while using less operations. Finally, limitations and weaknesses of DL/ML techniques are addressed. In par- ticular, adversarial examples, i.e. malicious inputs purposefully altered to fool the system into a wrong outcome. This document introduces a novel adversarial detector that relies on statistical information from the training-set to identify malicious samples. Given an input, it extracts a signature by leveraging the prediction of a NN to several distorted versions. Then, it uses a novel metric to compare the signature with a class representative vector and compute the detection score. The proposed method results very effective in various attack settings, achieving state-of-the-art detection performance.

T e r m i n : 29.06.2022, 14 Uhr

Zoom-Meeting: https://uni-wuppertal.zoom.us/j/98648388447?pwd=dENkM25XcUEzbkJaYktKeGlQemJRZz09