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PIXEL LEVEL BASED CONVOLUTIONAL NEURAL NETWORKS MODEL FOR ROBOT NAVIGATION

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Abstract. Vision-based autonomous robot navigation depicts a vivacious area of research with nu-merous algorithms been developed. Most of the algorithms either focus on scene-oriented simul-taneous localization and mapping (SLAM) or explore robot-oriented lane-detection/trajectory tracking.

Keywords: pixel level, convolutional neural networks, robot navigation.

The following questions were presented at the IV international conference Big data and Advanced Analytics in 2018. In many scientific field such as oil & gas, physics, or weather analysis, as well as in domains such as security or risk assessment, massive amounts of sensor generated measurement data is produced that has to be analyzed and mined to gain insights. The actual data is collected over time and the vast amount of observations lead to a collection of ordered data on a time line. Traditionally, time series data reflects high-dimensional data that requires large amounts of memory and storage space. In oil & gas, data collected on rigs may exceed the capacity potential of the network link (for uploading the data), as well as the actual local storage that is available. Hence, the traditional approach of defining machine learning algorithms that operate on the stored datasets is not feasible. This talk focuses on bringing machine learning to the source (sensors) and so reduce the dimensionality of the data in flight. The major challenge is to represent the meaningful information of the time series' data via a low-dimensional representation while capturing the essence of the data pattern in flight.Selection of the Machine Learning (ML) algorithms and ML Libraries affect accuracy, response time, scalability and success of implementing new Big Data applications. Unfortunately, algorithms providing high accuracy not necessarily provide good response time and scale well. Different algorithms take different training time and different efforts for operationalization. In this paper we will discuss results of collaborative efforts on benchmarking ML algorithms and libraries and review the algorithm of recommender selecting the appropriate ML algorithm and ML library for new Big Data applications, depending on relative importance of accuracy, response time, scalability and other criteria.

Vision-based autonomous robot navigation depicts a vivacious area of research with numerous algorithms been developed. Most of the algorithms either focus on scene-oriented simultaneous localization and mapping (SLAM) or explore robot-oriented lane-detection/trajectory tracking. The drawback of these methods is the very high computational cost and they all require rigorous labelling and calibration efforts. As an alternative, this presentation proposes a more lightweight robot navigation framework that is based on uncalibrated images. To simplify the orientation estimation, path prediction and to improve computational efficiency, the navigation problem is decomposed into a series of classification tasks. To mitigate the adverse effects of insufficient negative samples in the navigation via classification arena, a 360-degree camera for scene capturing is used. The classification is implemented as an end-to-end pixel level convolutional neural networks (CNN) that was trained on our own image dataset where the category labels can be efficiently collected. This pixel level CNN can predict potential path directions with good confidence levels based on uncalibrated images. For robot perception, CNNs with 3 RGB color channels have become standard. For robotics and computer vision tasks, it is common to borrow 1 of these architectures (along with pre-trained weights) and then to perform transfer learning or fine-tuning on task-specific data. For many tasks it is important not just to know that there is an object and where it is in an image (object detection), but also to know which pixels in each image correspond to that object (image segmentation). A Mask RCNN depicts a model that provides a modification to previous object detection architectures such as R-CNN or Faster R-CNN to serve this purpose. The ability to perform image segmentation is implemented by adding a fully convolutional network branch onto the existing network architectures. As the main branch generates bounding boxes and identifies the object's class, the fully convolutional branch that is provided with features from the main branch, generates image masks. This presentation focuses on assessing the potential of using deep-learning without a combination of depth images for robot navigation. Actual challenges and opportunities are discussed and results of the research are preseted.