End to End Learning for Visual Navigation

Ute Schiehlen[1], Natalie Reppekus[1], Raymond Chua[1], and Areeb Kamran[1]

[1]Technical University of Munich

Abstract

An important component in autonomous vehicles is visual navigation. We used an ordered sequence of frames recorded at the front of the car to obtain the steering angle using an end to end approach. Based on these images, we also computed the optical flow over adjacent frames to get additional motion information as input to our network and added an LSTM cell after the convolutional layers. End to end learning using *fully convolutional networks* (FCNs) has proven to be successful in many computer vision tasks such as Recognition[2], Object Detection[2], Localization[2, 1] and Semantic Segmentation [3]. One reason why end to end learning is so powerful is that it allows the network to learn the internal representation of the data using the provided training information.
Our approach is based on the network proposed in Bojarski et al.[**?**] consisting of five convolutional and three fully connected layers using the human steering angle as training signal. As this model did not fully exploit the temporal information of image sequences, we extended this architecture by training an additional convolutional network with optical flow calculated from the original images as input and optimizing the combined loss. As this approach yielded good results, we trained a second network consisting of a *Long-Short term memory* (LSTM) cell instead of the fully connected layers.

Data Preprocessing

Images

RGB

Random Horizontal Flip

Normalize

Convert to YUV

Zero-Mean

Labels

Second column first block

Content in your block.

Bibliography

References

[1] M. Oquab, L. Bottou, I. Laptev, and J. Sivic. Is object localization for free? - weakly-supervised learning with convolutional neural networks. In *CVPR*, pages 685–694. IEEE Computer Society, 2015.

[2] P. Sermanet, D. Eigen, X. Zhang, M. Mathieu, R. Fergus, and Y. LeCun. Overfeat: Integrated recognition, localization and detection using convolutional networks. *CoRR*, abs/1312.6229, 2013.

[3] E. Shelhamer, J. Long, and T. Darrell. Fully convolutional networks for semantic segmentation. *IEEE Trans. Pattern Anal. Mach. Intell.*, 39(4):640–651, 2017.