

Master Thesis

Autonomous creation of a synthetic dataset using a Generative Adversarial Network (GAN) for the detection of railway obstacles

Background In order to be able to train a model for object detection sufficiently in the area of machine learning, a correspondingly large dataset is required. For this reason, to achieve the wanted learning success, comparatively small datasets must be synthetically extended. Artificial intelligence in the form of a Generative Adversarial Network (GAN) can be used to produce such a synthetic dataset. GANs consist of two artificial neural networks, one is the generator, the other the discriminator. The goal of this work is to implement a GAN in the field of the SMART2 project, in which the generator produces synthetic images that are classified by the discriminator as real-world images, and thus to enlarge the dataset for training a convolutional neural network.

In the SMART2 project, obstacles on and near railway tracks should be detected. Therefore, it is necessary to have numerous images with corresponding obstacles available. During dynamic field tests in Serbia, some images with such obstacles could be generated, but the majority of the recorded images contains only railway tracks and no obstacles. With the help of the GAN to be implemented, synthetic images as realistic as possible are to be generated automatically in order to extend the dataset.

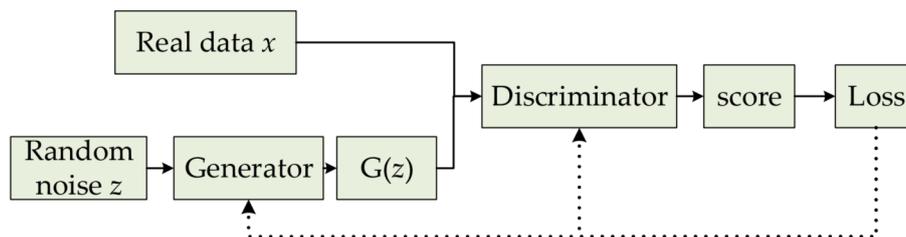


Figure 1: Process visualization of a Generative Adversarial Network [Guo+19]

Tasks

- Literature search
- Implementation of a generator network, which inserts obstacles in already existing images true to scale
- Development of an algorithm for scale estimation of inserted objects to achieve a high scale accuracy.
- Implementation of a discriminator network, which is trained with already existing training data.
- Evaluation of the created GAN.

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Requirements

- Good programming skills in python.
- Self-motivated, passionate about innovative applications comprising computer vision and machine learning.
- Understanding of machine learning and computer vision (sensor-based environment perception).

Literature Sample

- [Guo+19] Baoqing Guo et al. “High-Speed Railway Intruding Object Image Generating with Generative Adversarial Networks.” In: *Sensors* 19.14 (2019).
- [Mae+20] Hiroya Maeda et al. “Generative adversarial network for road damage detection.” In: *Computer-Aided Civil and Infrastructure Engineering* (2020).
- [Ree+16] Scott Reed et al. “Generative adversarial text to image synthesis.” In: *arXiv preprint arXiv:1605.05396* (2016).