BABEŞ-BOLYAI UNIVERSITY CLUJ-NAPOCA
FACULTY OF MATHEMATICS AND COMPUTER SCIENCE
SPECIALIZATION APPLIED COMPUTATIONAL INTELLIGENCE

DISSERTATION THESIS

ActiveRails: Improving Rails Semantic Segmentation through Active Learning Methods

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ABSTRACT

State-of-the-art machine learning models are data hungry. In autonomous driving, a tremendous amount of imagery data is collected at all times. Manual annotation of such high-resolution images represents a costly and inefficient process. Active Learning comes to aid annotators in their process to focus on labelling meaningful samples which lead to competitive machine learning models, useful for various prediction tasks. In this thesis, we study the task of Semantic Segmentation with the help of Active Learning, for improving the segmentation of rail blades in images taken from the ego-view of the train. We experiment with existing sampling techniques, as well as introduce our own, inspired by the Ant Colony Optimization algorithm. We also introduce two hybrid sampling techniques based on weighted sums. We validate the proposed method on the Image Classification and Semantic Segmentation tasks, on popular datasets. We conduct ablation experiments to find the ideal hyper-parameters, and study the scenario in which patches are considered, instead of entire images. Our results show competitive results of up to 78% mean Intersection over Union, reducing the annotation effort by 4 times.

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- Alexandrescu, A. R., Manole, A., Diosan, L. (2023). Railway Switch Classification Using Deep Neural Networks. In International Conference on Computer Vision Theory and Applications (VISIGRAPP-VISAPP), 769-776.
- Alexandrescu, A. R. (2024). ActiveRails: Improving Rails Semantic Segmentation using Active Learning Methods. In Young Talents International Conference (YTIC), University of Applied Sciences St. Pölten.
- Alexandrescu, A. R., Diosan, L. (2024). Active Learning for Railway Semantic Segmentation through Ant Colony Optimization. In International Conference on Knowledge-Based and Intelligent Information & Engineering Systems (KES). Accepted and will be presented in September 2024 in Seville, Spain.

Part of the results were also disseminated at The Developers Conference, organised on June 12, 2024, in Cluj-Napoca, Romania. The presentation was titled "How to do more with less: an Active Learning perspective".