ABBY-NET E^3-Systems Research Project Update 2019:
#9: Visual System for Autonomous Drones in Environmental Monitoring

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Project summary

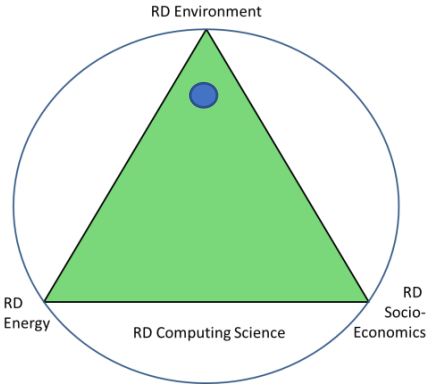
The goal of this master's thesis was to transfer recent advances in machine learning to the domain of unmanned aerial vehicles in the scope of environmental monitoring (EM). We first conducted experiments to assess the performance of state-of-the-art algorithms on high resolution, aerial video. These experiments showed very poor performance of all algorithms contained in the test. Thus, a machine learning pipeline was built to attribute for the biggest weaknesses of the algorithms, such that they can be used in EM applications. The pipeline consists of three building components: an object detector, an object tracker and a decision engine. The engine acts as the controlling entity in the pipeline. It decides upon viewing an incoming frame whether or not there are previously unseen objects. Depending on the decision of the engine, the pipeline either applies the detector to a zoomed subregion of the frame or simply propagates already detected objects along the temporal dimension.

Progress to date

The master's thesis was finished in December 2018. In June 2019 I have started working at Prof. Diepold's chair as a PhD student. Omur published some of his work in a paper with his supervisor in turkey. My next milestones will be to condense my thesis into a paper and to apply to a suitable journal.

Contribution to E3-system and Implications

Environmental Monitoring is an integral part of our understanding of nature, climate change and its impact on the ecosystem. In the past, satellites and manned aircraft were used to collect data. Both technologies have severe limitations and challenges, such as low spatial resolution, low temporal frequency and high cost. Thus, researchers recently started using drones to monitor nature. The process, albeit more efficient than satellites and regular aircraft, still takes a howling amount of time and effort. An autonomous system can drastically increase the productivity of the process. It can fly for an extended period of time, filter the area for cues and preprocess data before an expert evaluates the results. In total, the process would be more efficient, allow researchers to cover wider areas and react faster. My research was primarily focused on computer science and engineering.



Geographic location

Although the initial use-case was located in Alberta, the entirety of my work was done in Munich.

Final Outcomes:

This project was completed in December 2018 with a Masters Thesis. Omur Yildirim also completed a Masters thesis as well as a journal publication entitled: "Decision Process of Autonomous Drones for Environmental Monitoring" – please see https://ieeexplore.ieee.org/document/8778341. A publication from this project is being planned by Maximilian Ulmer with the tentative title: "Sequential Analysis of High-Resolution, Aerial Video with Deep Reinforcement Learning".