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Author: Mr. Szymon Bogus
Warsaw University of Technology (WUT), Poland

Dr. Maciej Zasuwa
Warsaw University of Technology (WUT), Poland

DETECTION AND REMOVAL OF CARS FROM SATELLITE IMAGERY OF URBAN AREAS WITH IMAGE RECONSTRUCTION USING DEEP LEARNING TECHNIQUES

Abstract

This paper focuses on the process of creating urban maps using deep learning tools. Assuming that many maps are being created with the help of satellite imagery, the growing number of cars in public space gradually makes the mapping process more difficult. Cars staying in traffics, parked on pavements or captured in move, blur important features of a city's infrastructure. The goal of this project was to create a tool to remove cars from a scenery and then reconstruct gaps after removal, so they look like surfaces of what was under removed cars.

The problem described above can be classified as an image processing task, in which certain class of objects has to be detected and then removed in a way which keeps the information of what was underneath the objects untouched. The solution separates into two objectives. The first stage is an image segmentation, initiated by the preprocessing. The segmentation of a town has to distinguish between two classes: car-regions and background. This is not a trivial task as car-regions are very small elements, while background is everything else- including small and big features of an image. No classical algorithms like: K-Nearest Neighbors, K-Means Clustering etc.. can handle this segmentation. Therefore the use of specific deep learning model is crucial to understand how does a car look like on a satellite imagery. The second stage of the solution has to implement a logic, which can predict what kind of surface was underneath a car before it was removed. To gain that knowledge it is necessary to analyze the surrounding of a car-region in search of patterns repetitions, edges of different features and colors distributions. The technique, that combines all these functionalities is called image inpaiting and it aims to reconstruct damaged images. This task once again can be handled by deep learning techniques to "fix" an image with on purpose created gaps- former cars.

This paper presents the results of custom utilization of two deep learning models and it indicates that there is a huge potential in combination of image segmentation and image inpaiting to serve as a tool for advanced Earth observation missions. Not only do obtained models apply to cars removal and reconstruction but they also allow to be fine-tunned to work with different objects(buildings, airplanes etc..), making it a versatile solution.