

Change Detection Using Machine Learning Algorithms for Development Monitoring

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ABSTRACT

The increasing need for easy and cost effective updating of geospatial data for Geographic Information Systems (GIS), in addition to the wide availability of high resolution imagery data and the exponential increase in computing power, fuel extensive research in automatic methods for change detection of manmade objects. This paper describes the general aspects of the problem and introduces the use of machine learning algorithms for supervised change detection; it describes a testing procedure with simulated data representing imagery and digital surface models (DSMs). The results of the testing procedure are summarized and discussed. In more detail, the first part of the paper presents an overview of international research bibliography in the subject of automatic change detection; it provides a concrete formulation of the problem's definition and analyzes the specific difficulties in making the process fully automatic. The next part focuses in machine learning algorithms and how they can be employed in supervised change detection. It emphasizes in three popular and robust algorithms: k-Nearest Neighbors (k-NN), Logistic Regression (LR) and linear Support Vector Machines (SVMs). The theoretic aspects of these methods are presented briefly and their advantages-disadvantages over more traditional approaches are elaborated. These algorithms are then tested with simulated data. The synthetic data were produced using scripts written in the Python programming language and they represent periodic imagery and DSMs. They were divided in training data, for tuning the parameters of each mathematical model, and testing data, for assessing the performance of each algorithm. The procedure took place in several phases where noise was gradually inserted in the training and testing sets to study the performance of the algorithms under difficult circumstances. All testing scripts were also written in Python. The results from the algorithms are compared to each other, to the actual truth and to a simpler differentiation oriented method developed in earlier work of the authors.

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