IMPROVED GEO-REFERENCING AND PRESCREENING FOR DETECTION OF BURIED EXPLOSIVE HAZARDS IN FORWARD-LOOKING INFRARED IMAGERY

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ABSTRACT

A new method for geo-referencing - the act of assigning location in physical space - of infrared imagery collected from a single camera on a moving platform under the assumption of a piecewise planar world is proposed and evaluated. The purpose is to develop an algorithm with less computational complexity than an arbitrary structure from motion approach, but with better accuracy than a naïve flat earth model approach. The proposed algorithm is used in conjunction with a forward-looking buried explosive hazard detection system which consists of an infrared camera mounted on a moving platform equipped with an inertial navigation system. This system requires fast and accurate geo-referencing in order to convert alarms detected in the captured images to world coordinates.

A new prescreening algorithm for detection of buried explosive hazards in infrared imagery is also proposed. The new algorithm uses a sliding window detector which extracts multi-scale histogram of oriented gradient features in a cell-structured fashion from dual grids centered inside the detection window. The feature vectors are classified using a SVM. This detector is compared to an existing prescreening algorithm that uses an ensemble of local RX anomaly detection filters trained via genetic algorithm. The proposed approach is shown to perform better across multiple cameras and data sets, and it does not require image preprocessing, such as contrast enhancement or denoising. Techniques for fast training and prediction of SVMs using additive kernels are combined. This allows the use of the non-linear histogram intersection and additive chi-square kernels with training time of a linear kernel SVM and prediction time independent of the number of support vectors.