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DEVELOPMENT OF A SINGLE-CHANNEL WILDFIRE DETECTION ALGORITHM FOR THE TUBIN MISSION

Abstract

Each year, forest fires result in significant ecological damages and economical losses. Dedicated, spaceborne detection systems can make a valuable contribution towards global monitoring and mapping of forest fires.

One of the primary objectives of the TUBIN mission of Technische Universität Berlin is the detection of forest fires and high-temperature events with a 20 kg class satellite using microbolometer sensor technology. Since the focal plane array of such camera does not require active cooling, it complies adequately with the scarcity of resources commonly found in this satellite class. However, microbolometer cameras are only sensitive to radiation in the thermal infrared range of the electromagnetic spectrum. They cannot resort to information on radiation within the medium-wavelength infrared, which is commonly combined with the thermal range to detect forest fires following the bi-spectral approach. Using a single-channel system, the sole deciding parameter for fire detection is the contrast of the signal within the thermal infrared range of the electromagnetic spectrum.

This paper discusses a series of newly conceptualised algorithms such as local and global threshold algorithms and compares their performance with standard ones available from literature. Each algorithm is reviewed, applied and assessed upon processing a simulated image set with uniform data level. These images are derived from payload data of spaceborne systems such as ASTER, BIRD and TET-1 containing high-temperature events. To this end, the data is radiometrically extrapolated and mapped to the sensor's response and, thereafter, binned to match the spatial resolution of the TUBIN payload. The TUBIN fire detection algorithm is developed iteratively using the most successful algorithms. Here, the detection rate of the respective algorithm is referenced against fire masks derived from and provided by the original satellite data. Parameters influencing the detection rate are, for instance, cloudiness, size and intensity of the fire, terrain of the scene and time of the day. As a result of this paper, a fire detection algorithm that can distinguish fire pixels from non-fire pixels with a certain accuracy and for a certain set of external factors (i.e. cloudiness, time of the day) is obtained. As an outlook, the first steps towards water and cloud detection algorithms are schematised.