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EXPLOITING SATELLITE FOCAL PLANE GEOMETRY FOR AUTOMATIC EXTRACTION OF TRAFFIC FLOW FROM SINGLE OPTICAL SATELLITE IMAGERY

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ABSTRACT:

The focal plane assembly of most push-broom scanner satellites is built up in a way that different multispectral or multispectral and panchromatic bands are not all acquired exactly at the same time. This effect is due to offsets of some millimeters of the CCD-lines in the focal plane. Exploiting this special configuration allows the detection of objects moving during this small time span. In this paper we present a method for automatic detection and extraction of moving objects – mainly traffic – from single very high resolution optical satellite imagery of different sensors. The sensors investigated are RapidEye, WorldView-2, Pléiades and also the new SkyBox satellites.

These sensors are like most of all very high resolution earth observation sensors built up as pushbroom scanners or a special pushbroom-frame-camera configuration in the case of SkyBox. To acquire different spectral bands for each band one CCD line is necessary. Most sensors have the panchromatic CCD line and the multispectral CCD scan lines mounted separately on the focal plane assembly with a distance of several millimeters. Others – like RapidEye or WorldView-2 – have even different multispectral CCD scan lines mounted separately. In the case of RapidEye there is a large gap in the size of several millimetres between the scan lines for red/red-edge/NIR and green/blue but only about 6.5 micrometres inside the lines between e.g. green and blue. This assembly results in the colored cyan/red corners which can be detected easily in each RapidEye image containing clouds. For WorldView-2 there exist two four-line multispectral CCD lines – one for the "classic" bands blue/green/red/NIR and one for extra bands coastal/yellow/red-edge/NIR2. Between these two four-channel-CCD-lines the panchromatic CCD-line is located. For Pléiades there exist one multispectral four-channel-CCD-line and one panchromatic CCD-line. In case of the SkyBox satellites the configuration is a little more complicated. SkyBox uses three frame sensors, each divided in a panchomatic part in the upper half and the four multispectral bands blue/green/red/NIR in the lower half of the frame. Operated in the scanning mode there is also a small time distance between each of the color bands and also to the panchromatic band.

So different sensors require different approaches for detecting moving objects. Since the objects are mapped on different positions only in different spectral bands also the change of spectral properties have to be taken into account. In case the main distance in the focal plane is between the multispectral and the panchromatic CCD-line like for Pléiades an approach for weighted integration to receive mostly identical images is investigated. Other approaches for RapidEye and WorldView-2 are also shown. From these intermediate bands difference images are calculated and a method for detecting the moving objects from these difference images is proposed.

Based on these presented methods images from different sensors are processed and the results are assessed for detection quality – how many moving objects can be detected, how many are missed – and accuracy – how accurate is the derived speed and size of the objects. Finally the results are discussed and an outlook for possible improvements towards operational processing is presented.