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Efficient implementation of morphological index for building/shadow extraction from remotely sensed images

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Abstract Morphological building index (MBI) and morphological shadow index (MSI) are recently developed techniques that aim at automatically detect buildings/shadows using high-resolution remotely sensed imagery. The traditional mathematical morphology operations are usually time-consuming as they are based on the consideration of a wide range of image-object properties, such as brightness, contrast, shapes, sizes, and in the application of series of repeated transformations (e.g., classical opening and closing operators). In the case of MBI and MSI, the computational complexity is also increased due to the use of multiscale and multidirectional morphological operators. In this paper, we provide a computationally efficient implementation of MBI and MSI algorithms which is specifically developed for commodity graphic processing units using NVIDIA CUDA. We perform the evaluation of the parallel version of the algorithms using two different NVIDIA architectures and three widely used hyperspectral data sets. Experimental results show that the computational burden

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5. Dell'Acqua F, Gamba P, Ferrari A, Palmason JA, Benediktsson JA, Arnason K (2010) Exploiting spectral and spatial information in hyperspectral urban data with high resolution. IEEE Geosci Remote Sens Lett 1(4):322–326
6. Huang X, Zhang L (2011) A multidirectional and multiscale morphological index for automatic building extraction from multispectral geoeye-1 imagery. Photogramm Eng Remote Sens 77:721–732
7. Plaza J, Plaza A, Barra C (2009) Multi-channel morphological profiles for classification of hyperspectral images using support vector machines. Sensors 9:196–218
8. Delgado J, Martin G, Plaza J, Jimenez LI, Plaza A (2016) Fast spatial preprocessing for spectral unmixing of hyperspectral data on graphics processing units. IEEE J Sel Topics Appl Earth Obs Remote Sens 9:952–961
9. Huang, X, Zhang L (2012) Morphological building/shadow index for building extraction from high-resolution imagery over urban areas. IEEE J Sel Topics Appl Earth Obs Remote Sens 5:161–172
10. Plaza A, Plaza J, Vegas H (2010) Improving the performance of hyperspectral image and signal processing algorithms using parallel, distributed and specialized hardware-based systems. Signal 50:293–315
11. Plaza A, Plaza J, Paz A (2010) Parallel heterogeneous cbir system for efficient hyperspectral image retrieval using spectral mixture analysis. Concurr Comput Pract Exp 22(9):293–315
12. Plaza A, Plaza J, Paz A, Sanchez S (2011) Parallel hyperspectral image and signal processing. IEEE Signal Process Mag 28:196–218