Chapter 11
Swarm Intelligence Based on Remote Sensing Image Fusion:
Comparison Between the Particle Swarm Optimization and the Flower Pollination Algorithm

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ABSTRACT

This chapter presents a remote sensing image fusion based on swarm intelligence. Image fusion is combining multi-sensor images in a single image that has most informative. Remote sensing image fusion is an effective way to extract a large volume of data from multisource images. However, traditional image fusion approaches cannot meet the requirements of applications because they can lose spatial information or distort spectral characteristics. The core of the image fusion is image fusion rules. The main challenge is getting suitable weight of fusion rule. This chapter proposes swarm intelligence to optimize the image fusion rule. Swarm intelligence algorithms are a family of global optimizers inspired by swarm phenomena in nature and have shown better performance. In this chapter, two remote sensing image fusion based on swarm intelligence algorithms, Particle Swarm Optimization (PSO) and flower pollination algorithm are presented to get an adaptive image fusion rule and comparative between them.

INTRODUCTION

Remote sensing satellite imagery plays an important role in extracting information, earth observation and knowledge of our environment with the help of various sensors (Xie et al., 2008). There are different types of sensors: passive, e.g. infrared and active, e.g. radars (Elachi et al., 2006). This chapter focuses on passive sensors covering the visible and infrared bands, which are having different spectral

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and spatial resolutions. Therefore, image fusion, which merges images of different spatial and spectral resolutions, plays an important role in information extraction (Pohlet al., 1998). Remote sensing image fusion is used to improve the quantitative analysis and facilitate image interpretation due to complementary information of different spectral and spatial resolution of data characteristics. It has also been proved that fused images could enhance the accuracy of remote sensing image classification, change detection and object recognition (Simone et al., 2002). There are major technical constraints like minimum data storage from a satellite platform in space, fewer bandwidth for communication with earth station etc. limits the satellite sensors from capturing images with high spatial and high spectral resolutions simultaneously (Pandit, et al., 2015). To overcome this limitation, image fusion has demonstrated to be a solution in remote sensing applications, which combine the information from panchromatic and multispectral images; propose to a single image which has higher spatial and multispectral resolutions. Recently, the multi-spectral and panchromatic image fusion has great important in the remote sensing field (Pandit, et al., 2015), the fused image can improve the information for real-world applications, such as agricultural management, environmental monitoring, land cover classification, land use and mineral exploration (Simone et al., 2002). The Pan and MS images produce in bundle by several commercial optical satellites, such as QuickBird, IKONOS, GeoEye, Landsat and SPOT. The Pan image characterizes by high spatial resolution. The spatial resolution reaches below half a meter for the Pan image for the commercial satellite product and the spectral resolution can be more than eight bands captured in the visible and near-infrared wavelengths for the MS images (Vivone et al.,2015). In the image fusion, the spatial and transform domains are fundamental approaches. In the image fusion, the spatial and transform domains are fundamental approaches (Singh et al., 2013). The pixel values of the source images are directly combined in the fusion process in spatial domain such as principal component analysis (PCA) (Gharbia et al., 2014) and sharp fusion (Tian et al., 2011). In the trans-form domain approaches, the most frequently used approaches are based on multi-scale transforms where fusion is performed on a number of various scales. The multiscale transforms usually used are pyramid transforms (Liu et al., 2001), the discrete wavelet transform (DWT) (Gharbia et al., 2014), the dual-tree complex wavelet transforms (Ray et al., 2006) and the curvelet transform (CVT) (Nencini et al., 2007). Most of the image fusion approach for Pan and MS images, their fu-sion rules were not adjusted adaptively. To improve the performance of the multi-scale image fusion approach based on the wavelet transform, many approaches of the meta-heuristics were applied to image fusion eld. Among the powerful meta-heuristics that gained the special attention of researchers, the Genetic Algorithm (GA) (Hong et al., 2011) and the Particle Swarm Optimization algorithm (PSO) (Gharbia et al., 2016), and bacteria foraging optimization algorithm (Agrawal et al.,2013). This chapter proposes two remote sensing image fusion based on the swarm intelligence, which are the remote sensing image fusion based on the Particle Swarm Optimization algorithm (PSO) and the remote sensing image fusion based on the flower pollination algorithm and the comparative between them. The FPA is proposed by Yang in (Yang, 2012), the FPA is an intelligent optimization algorithm that mimics the flower pollination behavior in nature. It is although relatively new, it has been widely researched over the past two years. Attribute reduction approach based on FPA is introduced in (Yamany, 2015). The wireless sensor network lifetime global optimization based on FPA is introduced in (Sharawi et al., 2014). In this chapter, the remote sensing image fusion based on FPA approach was proposed. First, the source images are decomposed by the SWT. Then the FPA is used to optimize the weight of the fusion rule. Finally, the ISWT is used to get the fused image. The PSO is ued as the same FPA. Then the comparative between the FPA and PSO based on remote sensing is presented. In this chapter, the remote sensing image fusion based on FPA and PSO approaches are

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