Road identification from remotely sensed images is crucial for many urban applications. Automatic acquisition of up-to-date and accurate information about roads is significant for various intelligent systems such as smart vehicle navigation, planning urban areas, roads monitoring, traffic management for intelligent transportation systems, and proper leading of military operations. Hence,all possible knowledge about roads properties must be incorporated in designing intelligent systems that interpret and decide with high precision the existence of roads in remotely sensed images.

Various extraction techniques rely on mathematical morphology (MM) that detects desired road structures through a sliding standard and empirically chosen structuring element (SE) over the input image. In this work, we design an intelligent process that not only combines spectral and spatial properties of roads but also impacts significantly the flexibility in retrieving spatial information. Indeed, we propose an adaptive algorithm that supplies tailored and most adequate arbitrary structuring elements for every image at hand. It has the significant impact of providing flexibility since every arbitrary generated SE is exclusively dedicated to the processed image. The processing consists of two major steps: a) the use of the particle swarm optimization algorithm to look for the adaptive SEs; b) we introduce prior knowledge, based on human visual interpretation of roads characteristics, and define some spatial indices to refine the results. The proposed method shows accuracy results that outperform standard approaches, which are limited to

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utilize only empirically chosen and standard SEs.

Other techniques use convolutional neural networks (CNNs). The different architectures inspired us to propose a convolutional neural network, which relies on a down-sampling segment followed by an up-sampling segment, for the purpose of road extraction from aerial images. Our model consists of convolutional layers only. The proposed encoder-decoder structure allows our network to retain boundary information, which is a critical feature for road identification; this feature is usually lost when dealing with other CNN models. Our design is characterized by its reduced complexity in terms of depth, number of parameters and memory size, contributing to

the use of fewer computer resources in both training and execution time. Experimental results on Massachusetts roads dataset demonstrate that the proposed architecture, although less complex, competes with the state of the art proposed approaches in terms of precision, recall, and accuracy