ABSTRACT

In recent years, both the development of high resolution satellite images and the amount of available aerial images have expanded and accessible easily. Analysis of these data is now absolutely necessary. Unfortunately, the technologies used to analyze all of these images have not kept pace, so a large portion of the job is still done manually by humans, which is costly, time-consuming, and error-prone. Due to these factors, there is a strong need for efficient and dependable techniques that can automatically analyze remote sensing images.

Road mapping is one area where the aforementioned problem is significant. Since road maps are so crucial to daily life, they are used extensively in many fields. They must be kept up to date because the world's road system is constantly evolving. Research on this topic is mainly motivated by the use of traffic management, city planning, road monitoring, GPS navigation, automatic map updating, and urban development Therefore, it is required to create a new, automatic, and trustworthy approach for extracting road networks. Understanding the specifics of road features, their singularity, and the context of their application is crucial in order to determine the ideal road extraction process.

However, even in high-resolution remote sensing images, background and roadways might be difficult to distinguish from complex background images because of the occlusion of trees and buildings. Now a day, Deep Learning, which has the computing power for massive data, has emerged as the most popular and effective classification approach. Deep learning techniques integrate feature extraction and classification, and it is based on the use of many processing layers to automatically learn suitable feature representation from the input data. Therefore, as compared to other classification-based methods, Deep Learning typically has higher generalization capabilities and it extract features automatically.

The automatic extraction of urban road networks from high-resolution remote sensing images is the subject of this thesis. Two different novel methods are developed for automatic road surface detection from high-resolution remote sensing images based on deep learning that detect effectively, efficiently and fast in manner. First, a modified U-Net is used to construct a semantic segmentation algorithm for road surface extraction. Due to the limited number of remote sensing images, data augmentation was performed. The semantic segmentation

network was initially trained using typical U-Net architecture using a higher number of training samples. Then, model performance is evaluated using various training and testing sample sizes. When training samples 362, this typical U-Net model performs well in terms of accuracy, IOU, DICE score, and picture visualization. Here, road and non-road pixels were simply segmented using binary semantic segmentation. Therefore, unlike standard U-Net, a deeper neural network encoder-decoder structure is not required. As a result, the modified U-Net has fewer convolution layers than the normal U-Net. The intersection over union (IOU) yielded a model performance of 93.71%, while the average segmentation time for a single image was 0.28 seconds. The outcome demonstrated that road networks may be successfully separated from remote sensing images with matching backdrops using the modified U-Net.

The second proposed approach, Gradient Descent Sea Lion Optimization (GDSLO) fusion of Sea Lion Optimization (SLnO) and Stochastic Gradient Descent (SGD) algorithms. GDSLO is used to train U-Net model. The proposed GDSLO based U-Net giving better results of road surface, road edges and centerline detection compared to existing literature methods. The model performance for road surface is measured by evaluation metrics, such as precision, recall, and F1-measure with the highest values of 0.888, 0.930, and 0.810, respectively. The road edge performance detected with precision, recall and F1-score are 0.801, 0.76, and 0.786 respectively. In the same way precision, recall, and F1-score for centerline detection is 0.800, 0.762, and 0.7999 respectively.

The organization of the thesis is as follows: chapter 1 covers the introduction of the deep learning methods. The numerous prevailing road network extraction approaches for the segmentation are reviewed in chapter 2. Chapter 3 portrays the proposed novel approach for semantics segmentation by Modified U-Net. A hybridization of SGD and SLO named as GDSLO newly designed optimizer is covered with implementation and results in the chapter 4.Finally, chapter 5 is the conclusion and future scope of thesis.