# Chapter 8
# Critical Review Analysis on Deep Learning-Based Segmentation Techniques for Water-Body Extraction

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## ABSTRACT

*The rapid advancement in the applications of remote sensing imagery had attracted considerable attention from researchers for digital image analysis. Researchers had performed the surveying and delineation of water bodies with excellent efforts and algorithms in the past, but they faced many challenges due to the varying characteristics of water such as its shape, size, and flow. Traditional methods employed for water body segmentation posed certain limitations in terms of accuracy, reliability, and robustness. Rapid growth in the automation category allowed researchers to incorporate deep learning models into the segmentation analysis. Deep learning segmentation models for water body feature extraction have shown promising results based on accuracy and precision. This chapter presents a brief review on the deep learning models used for water-body extraction with their merits over the traditional approaches. It also discusses existing results with challenges faced and future scope.*

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## 1. INTRODUCTION

Remote sensing technology: a key technique to extract information on land covers and environmental resources. Remotely sensed satellite images and data comprises of spectral, spatial and temporal resolutions. Satellites provide multispectral and hyper spectral images for digital image analysis. These images can be used for studying various image applications such as: image enhancement, image fusion, image segmentation etc. Out of these image segmentation has achieved researcher's interest using remote sensing image analysis. Image segmentation could be applied to variety of fields such as text recognition, land cover mapping, water-body feature extraction etc. Water-body segmentation is an important application of satellite image analysis which separates water and non-water regions. Water (in soil, vegetation or water-bodies) absorbs radiation at NIR bands achieving strong absorption at about 1.4, 1.9 and 2.7 μm. Almost all incident near-infrared and middle infrared (740-2500nm) radiation entering a pure water body is absorbed with negligible scattering. This makes the water-body appearing so dark in the black and white and color-infrared films. Studies have shown that the Landsat series provide effective images on water bodies for particularly carrying out surface water mapping and water delineation.

Rapid urbanization is increasingly deteriorating the water present in the urban environments. Hence, extraction of information from water bodies is essential for continuous evaluation of the status of water bodies. Extracting water-body features with the help of field surveys and GPS monitoring systems was time-consuming and inaccurate. Remote sensing technology has seen tremendous growth in last few years. With the help of this technique, researchers have tried to eradicate the problem of high-cost, more time-consumption and less accuracy as much as possible.

Before coming on to the era of machine learning and deep learning algorithms, researchers used several traditional methods for segmenting the water body images. Single-band, double-band, water-indices or band-ratio methods (NDWI [McFeeters, 1996], MNDWI [Xu, 2006], AWEI [Feyisa et al., 2014], etc.) were initially applied to segment the water bodies. Otsu applied thresholding method (Nobuyuki, 1979) to select the optimum threshold value for water-bodies and provide accurate separation of water-bodies from building shadows. Model-based methods achieved success in segmenting the rough as well as smooth surface water bodies, but these models were more sensitive towards the environmental noise. Though, object-based analysis received increased attention over many years on deriving image objects with high spatial resolutions, but they suffered from low computational efficiency. The need for automation gave rise to the use of artificial intelligence algorithms for water-body segmentation. Deep learning (Du, Cai, Wang et al, 2016) has achieved tremendous popularity in semantic segmentation methodology. The models designed for segmentation are partially or completely based on basic deep learning architectures

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