National Institute of Technology Rourkela

Defence Seminar

Seminar Title	: Systematic Extraction and Outburst Susceptibility Assessment of Glacier Lakes using Satellite Images
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Venue	: Seminar Room (No.: EC303), Electronics & Communication Engineering Department
Date and Time	: 25 Aug 2025 (09:00 a.m.)
Abstract	: The glacial lakes on the Himalayan region are increasing continuously. Various factors are responsible for increasing the glacial lakes including glacial retreat, glacial lake outburst floods (GLOFs), increased rainfall and human activities. Timely and accurate extraction of glacial lake information is crucial for understanding the complex interactions between natural phenomena and human activities in the Himalayan region. However, monitoring glacial lakes through traditional field surveys can be time-consuming, costly, and challenging, especially when dealing with vast or remote areas in the Himalayan region. Therefore, development of automatic techniques is essential, which can extract and monitor the glacial lake region with minimal human involvement. This thesis is focused on extracting the regions of glacial lakes from multispectral remote sensing images, especially in the context of monitoring and understanding glacial lake dynamics in the Himalayan region. To address spatial heterogeneity and enhance the performance of glacial lake boundary delineation, the first contribution proposes an advanced segmentation framework that integrates modified normalized cuts (Ncut) with superpixel-based algorithms, namely linear Iterative clustering (SLIC) and the region adjacency graph (RAG). However, the modified Ncut approach still relies on predefined rules and manual adjustments. Therefore, the second contribution introduces the glacial lake U-Net (GLU-Net) architecture, which uses a data-driven learning paradigm to significantly enhance segmentation performance while reducing the need for manual parameter fine-tuning. GLU-Net mitigates the problem of semantic feature loss during max-pooling by incorporating skip connections, thereby preserving critical features throughout the segmentation process. While GLU-Net demonstrated impressive performance, it did not explicitly incorporate salient feature mechanisms, which are essential for enhancing the identification of both global and local features. Therefore, the third contribution introduces a global&ndashlocal salient feature network (GloM-Net) to improve the accuracy of glacial lake region extraction and GLOF risk assessment. This dual-pathway mechanism, the proposed network achieves more precise boundary extraction and delivers a more reliable risk assessment for potential GLOF events. The fourth contribution presents the adaptable dilated U-Net (AdU-Net), a novel framework that integrates a dilated U-Net with nested connections and an adaptable vision transformer carrier encoder (AVi-TE) for glacial lake extraction. In addition, it introduces a modified spiking neural network (SNN) for evaluating GLOF) risk using Landsat 8 imagery. To validate the effectiveness of the proposed models, three regional datasets are utilized for glacial lake extraction, acquired from the Landsat 8 Operational Land Imager (OLI) sensor over the Imja, Chandra Basin, and Bhaga Basin regions. Collectively, these innovations form a robust and automated system for glacial lake monitoring and risk assessment within the broader context of climate change.