National Institute of Technology Rourkela

Synopsis Seminar

Seminar Title	: Integrated Flow analysis of a Meandering River through Geospatial, Laboratory-Based and Deep Learning Approaches
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Venue	: Civil Engineering Departmental Seminar Room
Date and Time	: 22 Jan 2025 (11.30 AM)

Abstract : This research focuses on a comprehensive assessment and monitoring of the morphology, hydrodynamics, and real time environmental health of the Mahanadi River. A prominent Indian peninsular river is studied, using integrated geospatial, experimental, and AI-driven approaches. The study investigates specific river morphometry parameters, including bank erosion, active channel bank shift, and sinuosity behaviour, along a 270 km stretch from Baipur to Gopinathpur, Cuttack. To simplify analysis, the stretch is divided into nine reaches. The Digital Shoreline Analysis System (DSAS) and Kalman Filter Model were utilized to assess and predict riverbank shifts. Results reveal significant instability in most reaches, with the one reach (Kantilo) showing pronounced meandering pattern. Right bank erosion was found to be more severe, with active channel shifts ranging from 222 to -2900 meters, while left bank active channel shifts varied between 996 to -1600 meters. Additionally, barrages, dams, and climate change have significantly impacted the flow area ratio and stability, disrupting aquatic ecosystems and local livelihoods. To complement the geospatial analysis and to identify the reason behind these variations of morphology, a controlled experimental study was performed to examine the three-dimensional turbulence flow properties in a scaled meandering channel under subcritical flow conditions. Critical hydrodynamic parameters such as velocity profiles, turbulent kinetic energy, skewness, and kurtosis, Renyolds shear stress (RSS), Turbulent intensity etc. were analysed using Acoustic Doppler Velocimeters (ADV). The results demonstrated distinct spatial variations in flow dynamics and turbulence characteristics, emphasizing the influence of channel geometry and flow conditions. These insights are crucial for understanding complex flow behaviours and designing effective river management strategies. Lastly, leveraging deep learning techniques, AI-driven real-time automated monitoring models were analysed using river imagery data. Which reveals that YOLOv11 achieved an impressive mean Average Precision (mAP@50) of 91%, showcasing its effectiveness in segmenting diverse waterbody types. The same model can be preferred to use in different cutting-edge devices for monitoring the river in real time. This platform enables efficient and continuous assessment of river dynamics, enhancing decision-making for river restoration, flood control, and ecological sustainability. By integrating geospatial analysis, experimental modelling, and AI-based automation, this study provides a holistic understanding of the morphology and hydrodynamics of a meandering River, offering valuable insights for sustainable river management and restoration projects.

Keywords: River Morphology, DSAS, Experimental investigation, Meandering channel, Mahanadi River, Froude number model, Turbulence dynamics, Deep Learning.