

ICRAMCS 2025

THE SEVENTH EDITION OF THE INTERNATIONAL CONFERENCE ON
RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE

April 24-25-26, 2025 | Marrakech, Morocco



Toward Reliable and Explainable Retinal Vessel Segmentation Using Advanced Deep Architectures

Communication Info

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Keywords:

Deep Learning ,
Retinal Imaging ,
Vessel Segmentation .

Abstract

The precise identification of retinal vascular structures is a fundamental requirement for the early diagnosis of various ocular and systemic conditions [1]. Despite the success of standard deep learning models, achieving consistent reliability across varied datasets and providing interpretable results remain significant hurdles. This study presents a rigorous comparative analysis of four sophisticated architectures: the standard U-Net, Attention U-Net [2], ResU-Net [3], and a hybrid Residual Attention U-Net [4]. To ensure a fair assessment, we implemented a unified preprocessing framework utilizing green-channel extraction and data augmentation on the DRIVE, STARE, and REFUGE datasets. Our experimental results indicate that the integration of residual connections and attention gates significantly enhances the model's ability to capture fine capillaries. Notably, the Residual Attention U-Net demonstrated superior performance in terms of robustness. Furthermore, we utilize attention-based visualization [5] to offer insights into the model's decision-making process, thereby increasing transparency of the segmentation system. These results suggest that such advanced hybrid models provide a more trustworthy and reliable tool for automated ophthalmic screening.

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