



**UNDERGRADUATE THESIS**

**COMPARISON OF CROSS FUSION CHANNEL  
ATTENTION AND COORDINATE ATTENTION IN  
THE CAS-UNET ARCHITECTURE FOR  
RETINAL BLOOD VESSEL SEGMENTATION**

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2026**

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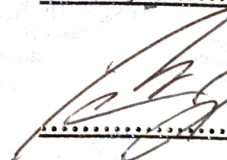
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## ABSTRACT

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Thesis Title : COMPARISON OF CROSS-FUSION CHANNEL  
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Retinal blood vessel segmentation is a crucial step in fundus image analysis to support the early detection of ocular diseases, such as diabetic retinopathy. However, the thin, branching structures of blood vessels and their low contrast with the background make the segmentation process a challenging task. This study aims to develop and compare the performance of the CAS-UNet architecture with two attention mechanisms, namely Cross-Fusion Channel Attention (CFCA) and Coordinate Attention (CA), for retinal blood vessel segmentation. The study was conducted using a combined dataset of DRIVE and CHASE\_DB1. The methodology includes data collection and splitting, preprocessing, patch extraction, model training, and evaluation using accuracy, sensitivity, specificity, F1-score, and Intersection over Union (IoU) metrics. Several parameter *testing* scenarios were performed to obtain the optimal configuration. The results indicate that both models achieve high and stable performance. Under the best configuration, CAS-UNet with CFCA achieved an accuracy of 97.10%, sensitivity of 82.45%, specificity of 98.39%, F1-score of 82.11%, and IoU of 69.65%. Meanwhile, CAS-UNet with CA achieved an accuracy of 97.12%, sensitivity of 80.20%, specificity of 98.60%, F1-score of 81.79%, and IoU of 69.18%. Although both models show comparable accuracy, the CFCA-based model outperforms CA in terms of sensitivity, F1-score, and IoU. Therefore, it can be concluded that CAS-UNet with the CFCA module is more optimal for retinal blood vessel segmentation compared to the CA module. This study is expected to serve as a reference for the development of deep learning-based medical image segmentation methods.

**Keywords :** Image Segmentation, Retinal Blood Vessels, CAS-UNet, CFCA, Coordinate Attention, Deep Learning

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Surabaya, June 11, 2026

The Author

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