Abstract

Fatty liver disease, also known as hepatic steatosis, is a prevalent condition where fat accumulates within liver cells. Determining the severity of hepatic steatosis is crucial for guiding patient treatment, often requiring histopathological imaging of liver tissue. Accurate segmentation of steatosis droplets in these images is essential for precise severity assessment. While deep learning models have been employed for this task, many existing approaches rely on high parameter counts and struggle with the accurate segmentation of small steatosis droplets. This highlights the need for a more efficient and accurate solution. In this study, we explore the performance of two deep learning architectures, U-Net and UNet3+, for semantic segmentation of steatosis droplets. A dataset comprising 385 annotated histopathological image patches with three classes—background, tissue, and steatosis—was utilized. Performance was evaluated using metrics such as mean Intersection over Union (mIoU) and model complexity. Our results demonstrate that the UNet3+ architecture significantly outperforms the traditional U-Net in both segmentation accuracy and efficiency. Furthermore, the use of model output integration improves the segmentation of small steatosis droplets without compromising accuracy of larger steatosis droplets. The highest mIoU of 87.84% was achieved using UNet3+ with model output integration, underscoring its potential for lightweight and effective semantic segmentation. This study contributes a robust approach for automated hepatic steatosis analysis, offering enhanced diagnostic precision and computational efficiency. The implications of this study also suggest that UNet3+ could further be optimized for more complex semantic segmentation tasks in medical field.

Keywords: hepatic steatosis, histopathological image, semantic segmentation, deep learning, U-Net