

Name: Khondker Fariha Hossain

Institution: University of Nevada, Reno

Mentor: Dr. Alireza Tavakkoli

Email: Khonderfarihah@unr.edu

Abstract:

Wildfires are becoming more frequent and intense, posing serious threats to ecosystems, communities, and air quality. Accurately detecting fire perimeters, tracking smoke plumes, and assessing damage are critical for effective wildfire management. However, existing deep learning models for image segmentation are often too complex and computationally expensive to be deployed in real-world fire monitoring systems, especially in remote or resource-limited environments.

To bridge this gap, we introduce Teach-Former, a lightweight and efficient deep learning framework designed to segment complex images with high accuracy while keeping computational demands low. Originally developed for medical image segmentation, Teach-Former utilizes a knowledge distillation (KD) approach that allows a smaller model to learn from multiple high-performing models (teachers), ensuring it retains their accuracy while operating at a fraction of the computational cost. The model's Transformer-based architecture enhances its ability to capture spatial and contextual relationships, making it well-suited for wildfire-related applications.

By adapting Teach-Former to fire science, we aim to improve wildfire segmentation, smoke detection, and post-fire damage assessment using data from satellites, drones, LiDAR, and thermal sensors. Unlike traditional models that struggle with the complexity of multi-source fire data, Teach-Former efficiently integrates these modalities, allowing for faster and more precise fire mapping. This efficiency makes it deployable on edge devices, drones, and field sensors, ensuring real-time insights for emergency responders and researchers.

We plan to evaluate Teach-Former on wildfire datasets, including NASA FIRMS and HDRFS imagery, to demonstrate its ability to identify fire perimeters, monitor burn severity, and support data-driven decision-making. By providing a scalable, high-performance segmentation tool, Teach-Former aligns with HDRFS's mission to enhance wildfire research and response, ultimately helping communities better prepare for and mitigate fire-related risks.