Sustainable Pavement Management: Harnessing Advanced Machine Learning For Enhanced Road Maintenance

In this study, we introduce an advanced system for sustainable pavement management that leverages cutting-edge machine learning and computer vision techniques to detect and classify pavement damage. By utilizing models such as EfficientNetB3, ResNet18, and ResNet50, we develop robust classifiers capable of accurately identifying various types of pavement distress. To further enhance our dataset, we employ a Swin Transformer-based Generative Adversarial Network (GAN) to synthetically generate images of pavement cracks, thereby augmenting the training data. Our approach aims to improve the efficiency and accuracy of pavement damage assessment, contributing to more effective and sustainable road maintenance practices. This research aligns with the sustainable development goals by fostering innovative methods that extend the lifespan of infrastructure, reducing the need for resource-intensive repairs, and promoting the longevity and reliability of road networks. The outcomes of this study are discussed in terms of their potential impact on infrastructure safety and sustainability, with suggestions for future research directions. This study demonstrates how integrating advanced machine learning techniques into pavement management systems can enhance decision-making, optimize resource allocation, and improve the sustainability of infrastructure maintenance practices. By leveraging big data and sophisticated algorithms, stakeholders can proactively address pavement deterioration, extend asset lifespan, and optimize maintenance efforts based on real-time data-driven insights.

Kshitij Ijari *and Carlos Paternina-Arboleda*

This research is supported by the Computational Science Research Center (CSRC) at San Diego State University