Title: UAV-Assisted Photogrammetry and Deep Learning for Rapid Structural Inspection and Automated Damage Mapping of Industrial Structures

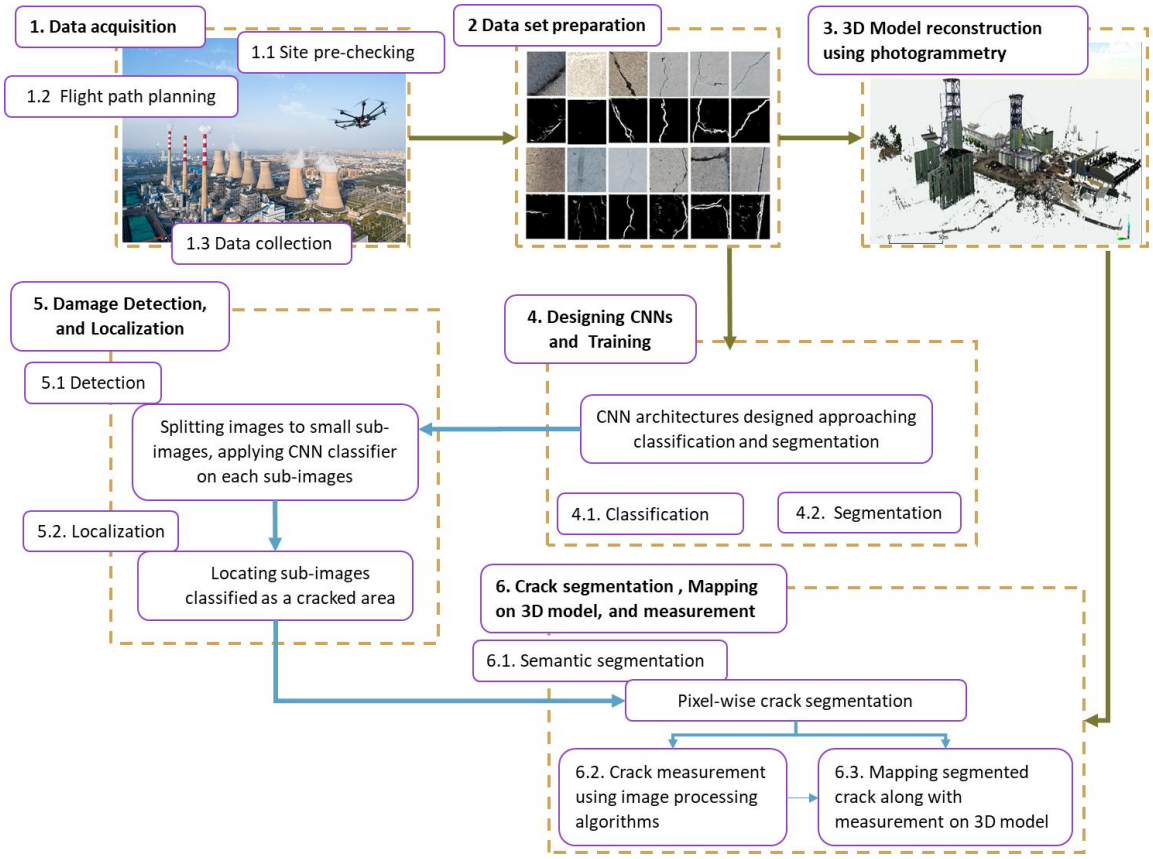
Duration: April 2024 to September 2025

Objectives:

- Development of a real-time, automated, and reliable deep learning framework integrated with image processing techniques for object detection, segmentation, and damage assessment.
- Implement image-based 3D reconstruction techniques to generate a comprehensive digital model incorporating damage mapping for decision-making.
- To undertake a case study to test, validate, and demonstrate the proposed framework

Progress Highlights:

- ❖ Pre-trained CNN models are developed for damage-type classification accounting data imbalance. DL models are trained, validated, and tested on publicly available benchmark datasets and real structures data.
- ❖ Performance evaluation studies focused on model transfer, sample knowledge, and parameter transfer in the classification problems, providing insights into adaptability and generalization.
- ❖ An explainable custom CNN model with t-SNE visualization is developed for damage-type classification.
- ❖ Custom and pre-trained CNN, U-Net, and YOLO algorithms are developed for object detection and segmentation, specifically for surface crack detection in structural components and corrosion area mapping in steel structures.
- ❖ A semi-supervised segmentation algorithm is developed, integrating a highly accurate supervised object detection model with zero-shot unsupervised segmentation. The key advantage is its ability to achieve pixel-level accuracy in mapping defects using only object detection labels.
- ❖ The proposed semi-supervised segmentation model achieves state-of-the-art performance in terms of accuracy with an average Dice Score of 0.7, comparable to that of the established supervised segmentation algorithms such as U-Net and YOLO-seg algorithms



Integrated framework for condition assessment of industrial structures

Future Programme:

- Hybrid deep learning and image processing software (python-based, open source) for automated damage identification and assessment with usage guidelines handbook

Project Leader:

Dr. J. Prawin

Team:

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Date: December 2024