

Automated Measurement of Bridge Expansion Joints Using High-Resolution Imaging and Prompt Engineering with Multimodal Deep Learning

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ABSTRACT

In bridge engineering, expansion joints are typically employed as specialized connectors to manage the structural deformation of highway bridges caused by various loads [1]. These joints often become some of the most vulnerable parts of bridges due to the repeated impact of heavy vehicle loads and environmental factors. Therefore, obtaining timely and accurate information about the expansion joints is crucial for maintaining structural integrity of the bridge and ensuring traffic safety. However, due to the manual process for obtaining information about the joints, workers typically face dangerous, time-consuming, and labor-intensive tasks. To automate this process, a proposed method is introduced that can robustly and automatically detect joints from high-resolution images with minimal training as illustrated in Figure 1. Detecting the distance of expansion joints with minimal training is achieved by utilizing a pretrained vision-language multimodality deep learning model [2] and a foundational computer vision model for semantic segmentation [3] with domain-specific knowledge-based prompt engineering. This automated approach enhances the efficiency and safety of inspection processes and ensures more reliable maintenance of bridge infrastructure.

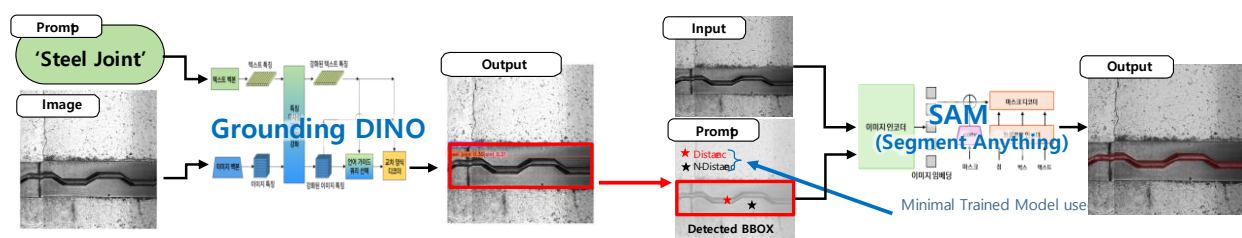


Fig. 1 Computational meshes for Gyeongju station

REFERENCES

- 1 Graduate student
- 2 Professor
- 3 Professor

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- [1] He, A., Dong, Z., Zhang, H., Zhang, A. A., Qiu, S., Liu, Y., ... & Lin, Z. (2023). Automated Pixel-Level Detection of Expansion Joints on Asphalt Pavement Using a Deep-Learning-Based Approach. *Structural Control and Health Monitoring*, 2023.
- [2] Liu, S., Zeng, Z., Ren, T., Li, F., Zhang, H., Yang, J., ... & Zhang, L. (2023). Grounding dino: Marrying dino with grounded pre-training for open-set object detection. *arXiv preprint arXiv:2303.05499*.
- [3] Kirillov, A., Mintun, E., Ravi, N., Mao, H., Rolland, C., Gustafson, L., ... & Girshick, R. (2023). Segment anything. In *Proceedings of the IEEE/CVF International Conference on Computer Vision* (pp. 4015-4026).