Deep Learning Algorithms on SWIR Images for Road Perception in Harsh Weather

Current autonomous driving algorithms heavily rely on the visible spectrum, which is prone to performance degradation in adverse conditions like fog, rain, snow, glare, and high contrast. Short-wave infrared (SWIR) has opened up new perspectives to enhance perception in such situations, which also offers several advantages over NIR and LWIR bands. This project aims to analyze the feasibility of using SWIR images to improve deep learning based detection and segmentation in road driving scenarios. To address the limited availability of annotated SWIR data, this project also aims to study RGB–SWIR image translation using generative models, including Generative Adversarial Networks (GANs) and diffusion-based approaches. Preliminary work shows that although SWIR exhibits superior performance in terms of penetration through haze and fog and reduced sensitivity to illumination variations, there is need for specialization: adapting the detection model to the SWIR domain via fine-tuning, domain adaptation, distillation etc. This project contributes to the advancement of multimodal perception systems for autonomous vehicles and advanced driver-assistance systems (ADAS).

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