

Thesis Defense

Computer Science Master's Program

“Lightweight Frontend–Backend Adaptation for Frozen 3D Foundation Models under Low-Light Robotic Imagery”

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Abstract:

Small vision-based systems increasingly rely on camera input to estimate motion and reconstruct surrounding 3D environments. While modern reconstruction pipelines perform well under normal illumination, practical deployments often occur in dim corridors, nighttime environments, and other low-light conditions where images lose contrast, texture, and reliable visual features.

This thesis investigates low-light adaptation for vision-based 3D reconstruction using a frozen pretrained geometry model. Rather than retraining the underlying network, the proposed pipeline augments it with two lightweight components: an image-restoration frontend that enhances degraded RGB inputs prior to inference, and a trajectory-refinement backend that improves pose consistency after inference.

The approach is evaluated on RGB-D benchmark sequences with synthetic low-light corruption as well as real fixed-exposure corridor videos captured under day, dim, and nighttime conditions. Experimental results show improvements in camera trajectory estimation and recovery of usable 3D structure under challenging illumination conditions. These findings demonstrate that low-light robustness can be enhanced by adapting the inputs and outputs of a frozen 3D reconstruction model without modifying or retraining the core geometry network.

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Time: 10:00 AM – 12:00 PM

Location: 14-238b

Committee: Dr. Jonathan Ventura, Dr. Franz Kurfess, Dr. Alex Bisberg