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Collaborative Digital Modeling Simulation

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Background and Inspiration

Background

Building inspection and monitoring is a rather expensive and time-consuming process requiring specialized equipment and expertise.

Can we use Visual Computing and SLAM to tackle this problem?

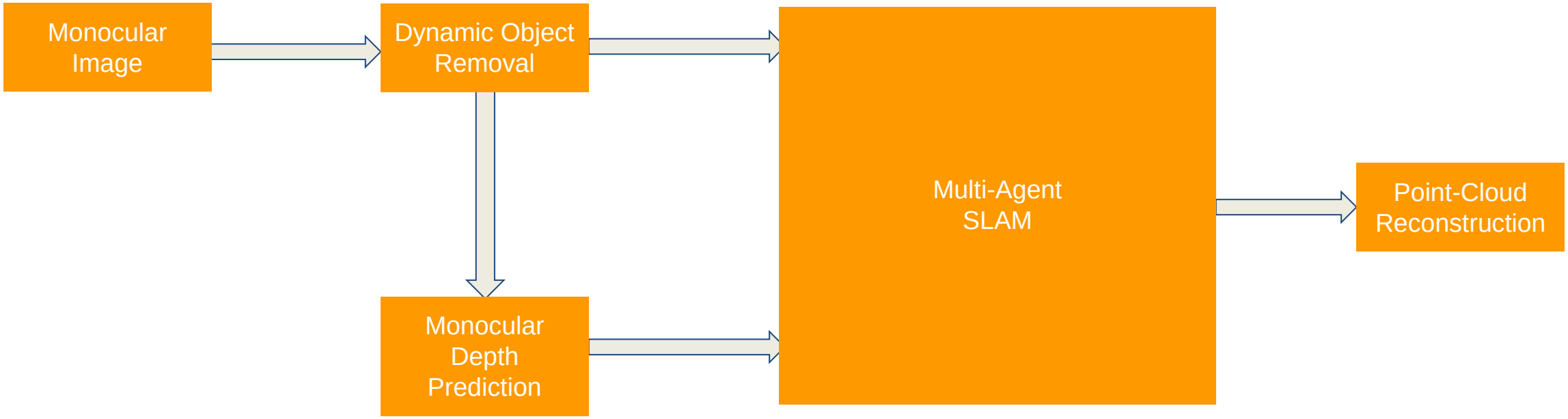
Challenges

Current multi-agent SLAM systems work well ONLY in static environments.

Aim

To develop a distributed,scalable system with minimal human intervention requiring only monocular vision, and IMUs capable of working in dynamic environments.

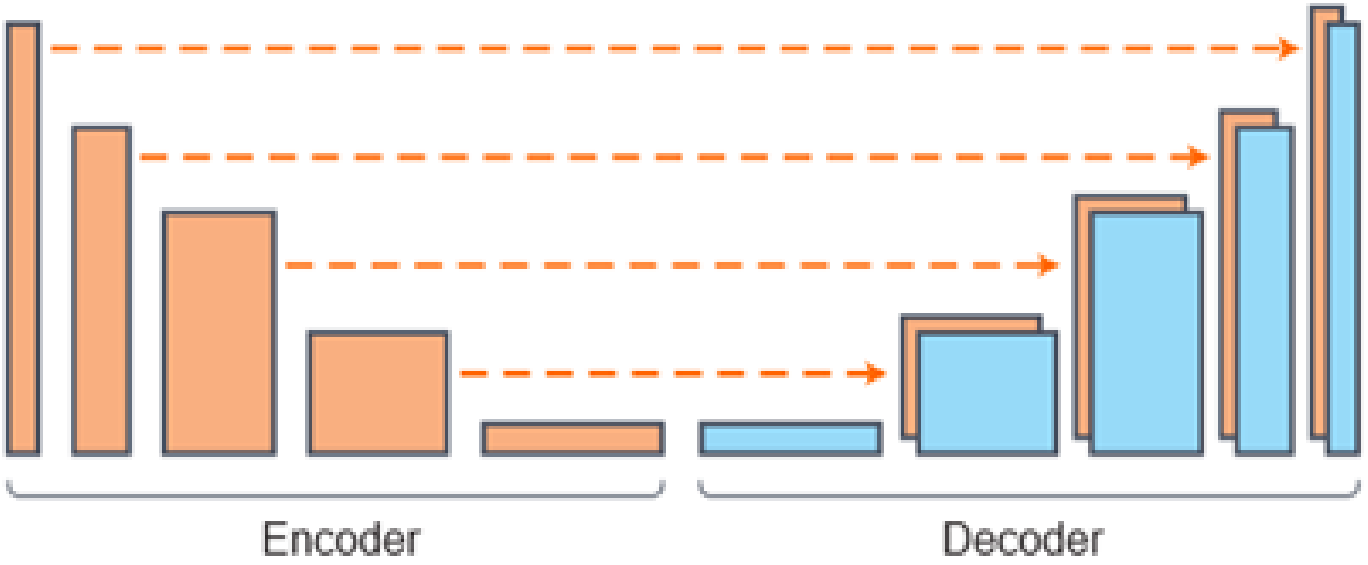
Proposed SLAM System

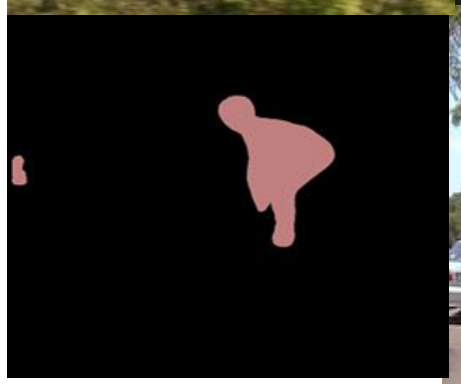


Modularity maintained!

Dynamic Object Removal Block

We treat this as a segmentation+image inpainting problem





Dense U-Net Backbone for Semantic Segmentation

Can be replaced with any standard segmentation architecture. - DeepLabv3 is promising.

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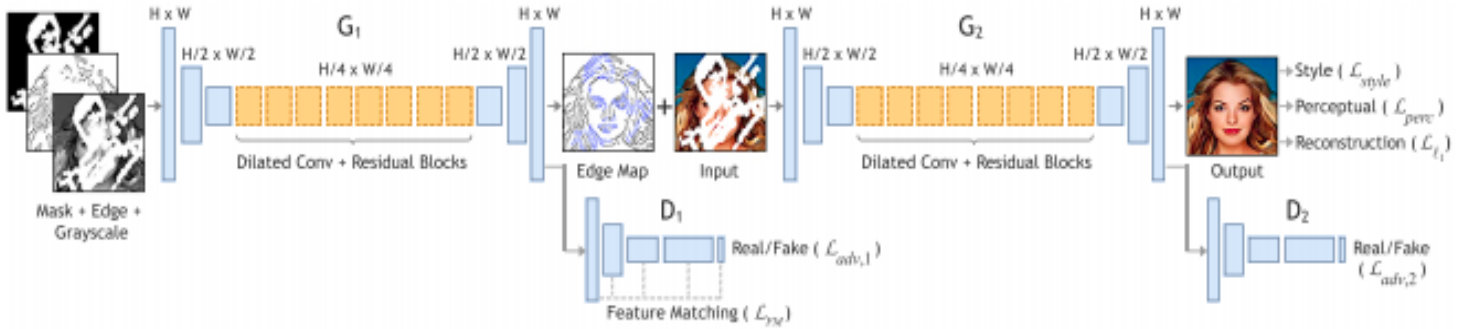

Edge Connect for image inpainting

Again can be replaced with any standard inpainting architecture.

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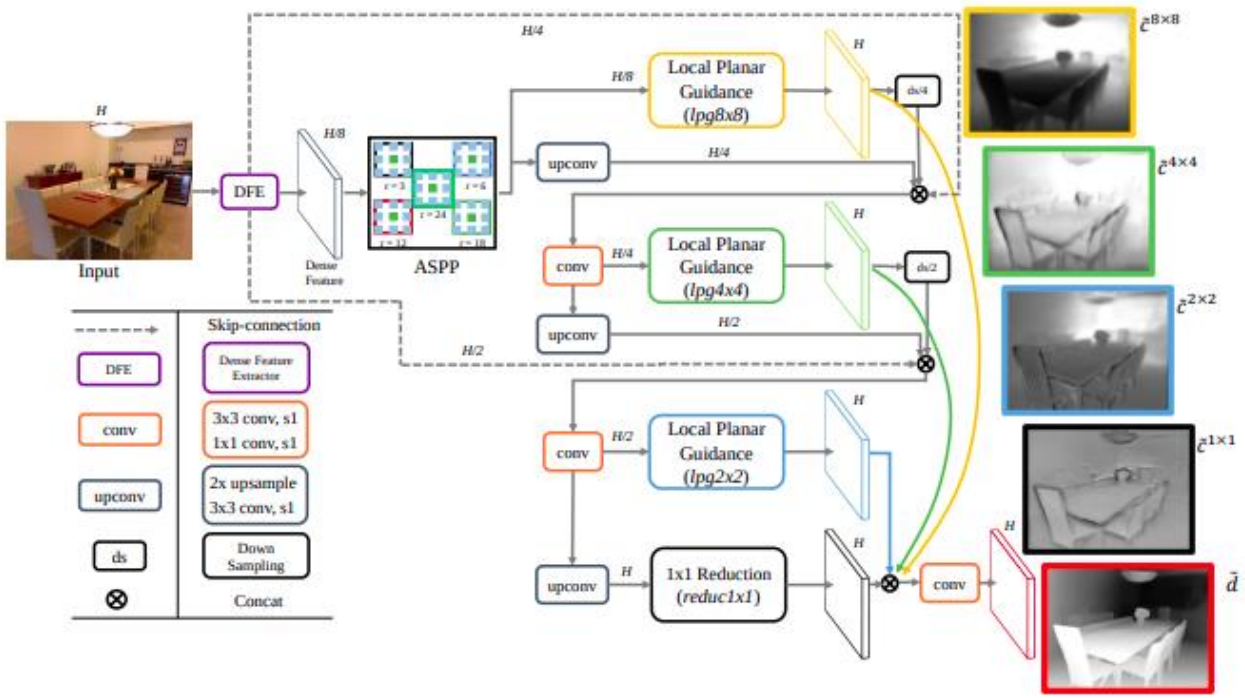
Monocular Depth Prediction Block

Perform Monocular Depth Prediction on processed image



Big To Small Monocular Depth Prediction

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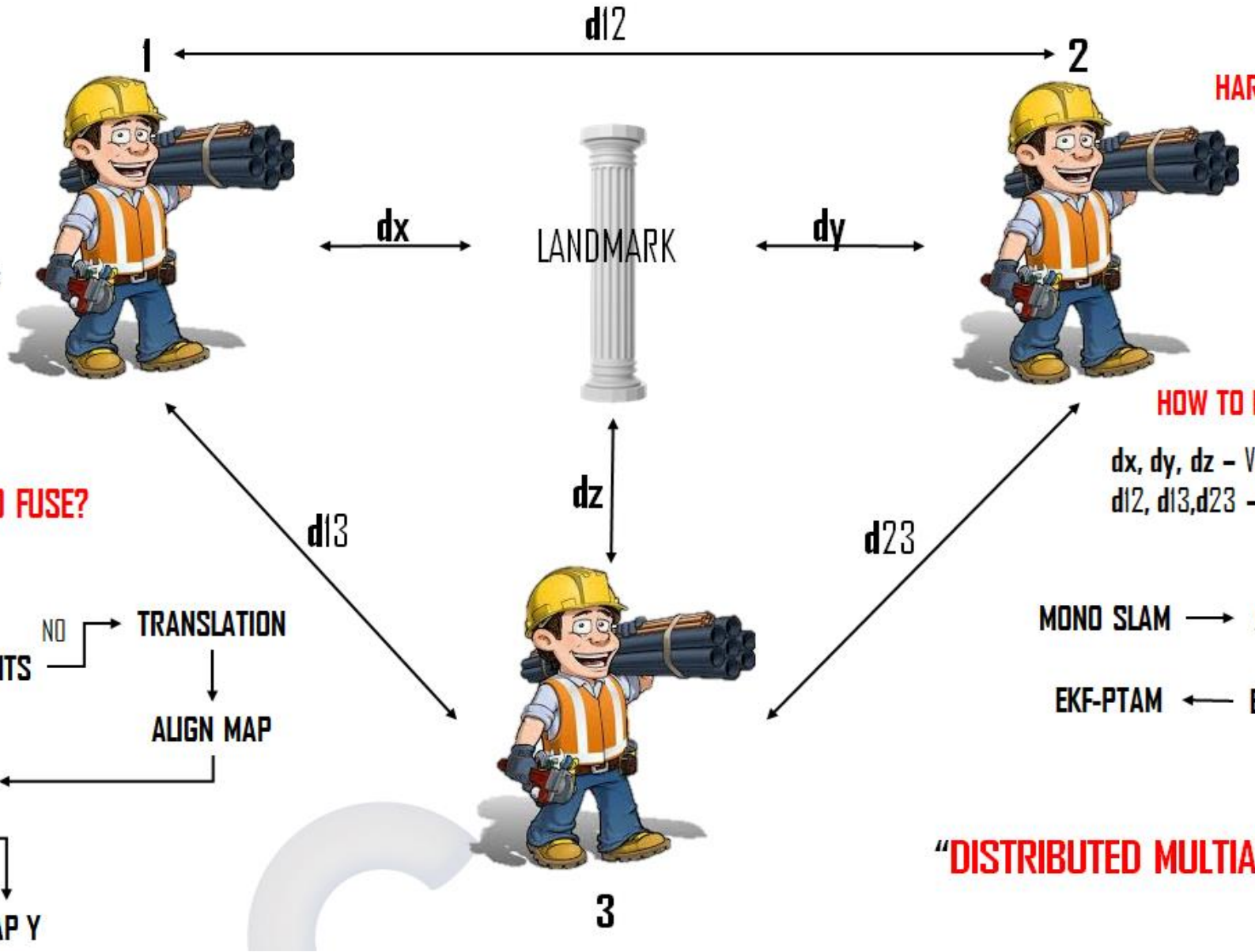
Proposed SLAM Architectures



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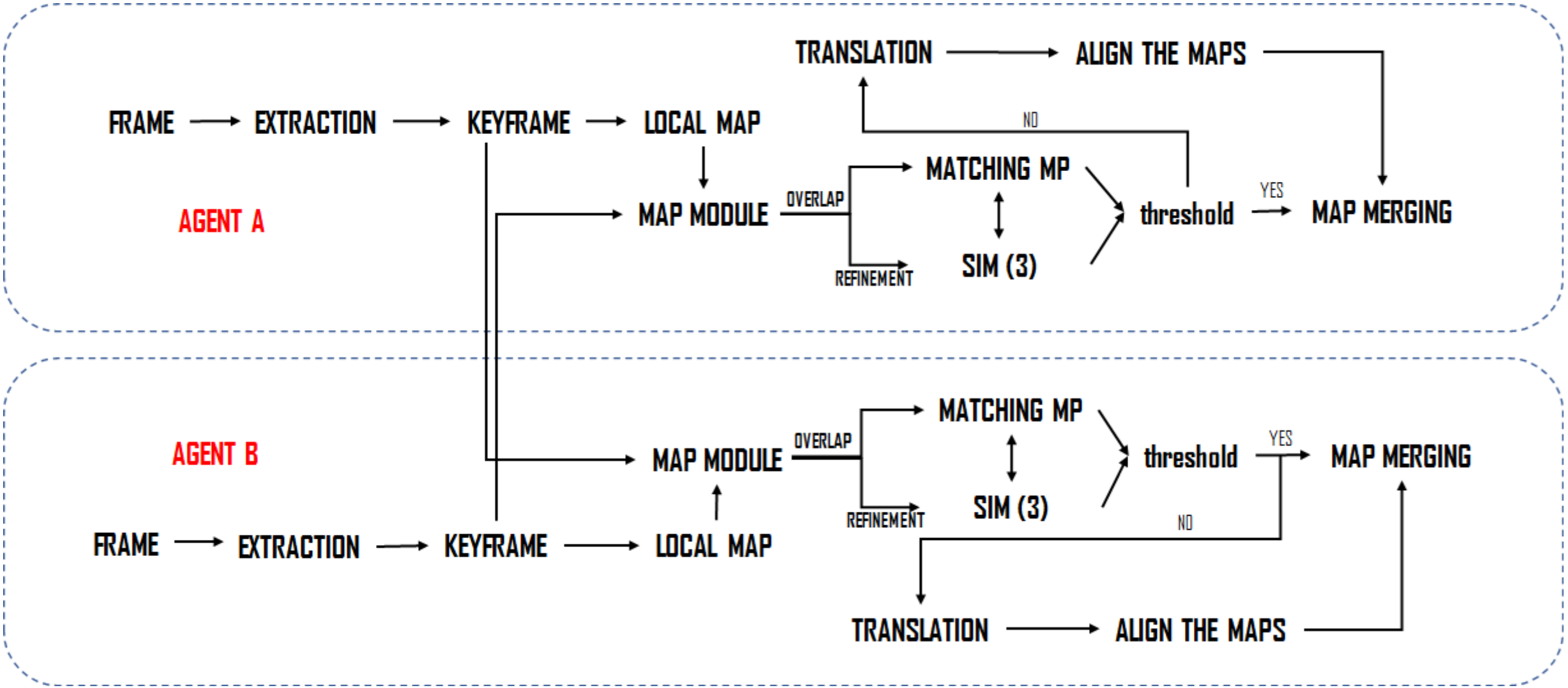
Proposed SLAM Architectures



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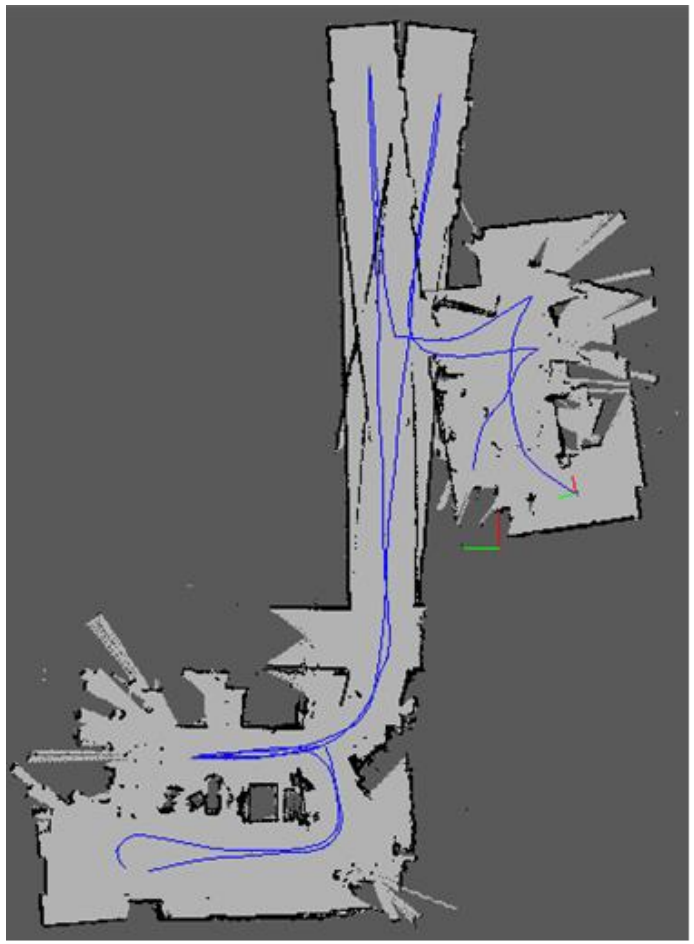
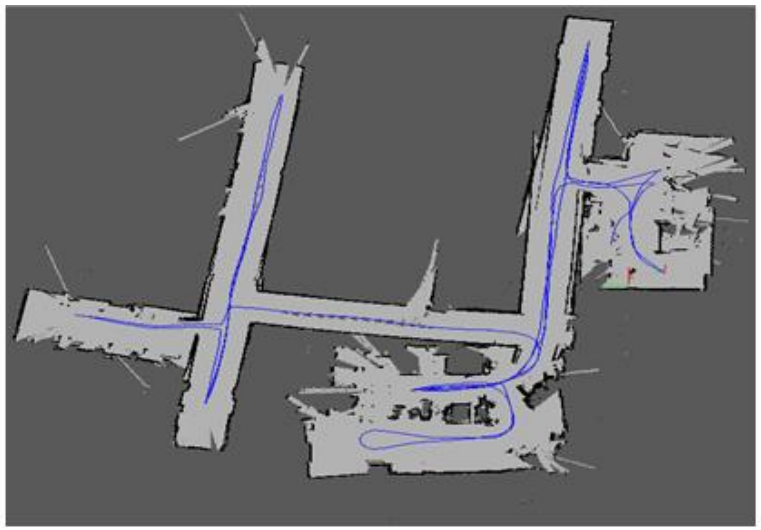
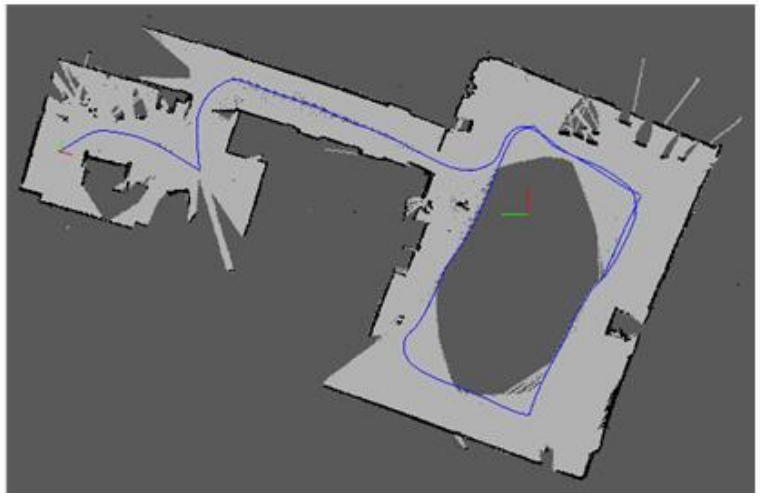
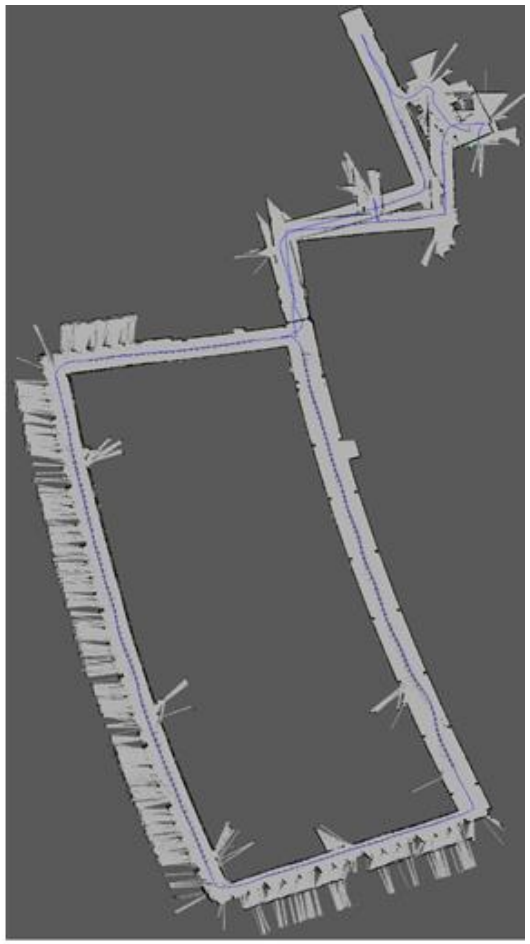
RTABMap Multi-Session Simulation









MAPS

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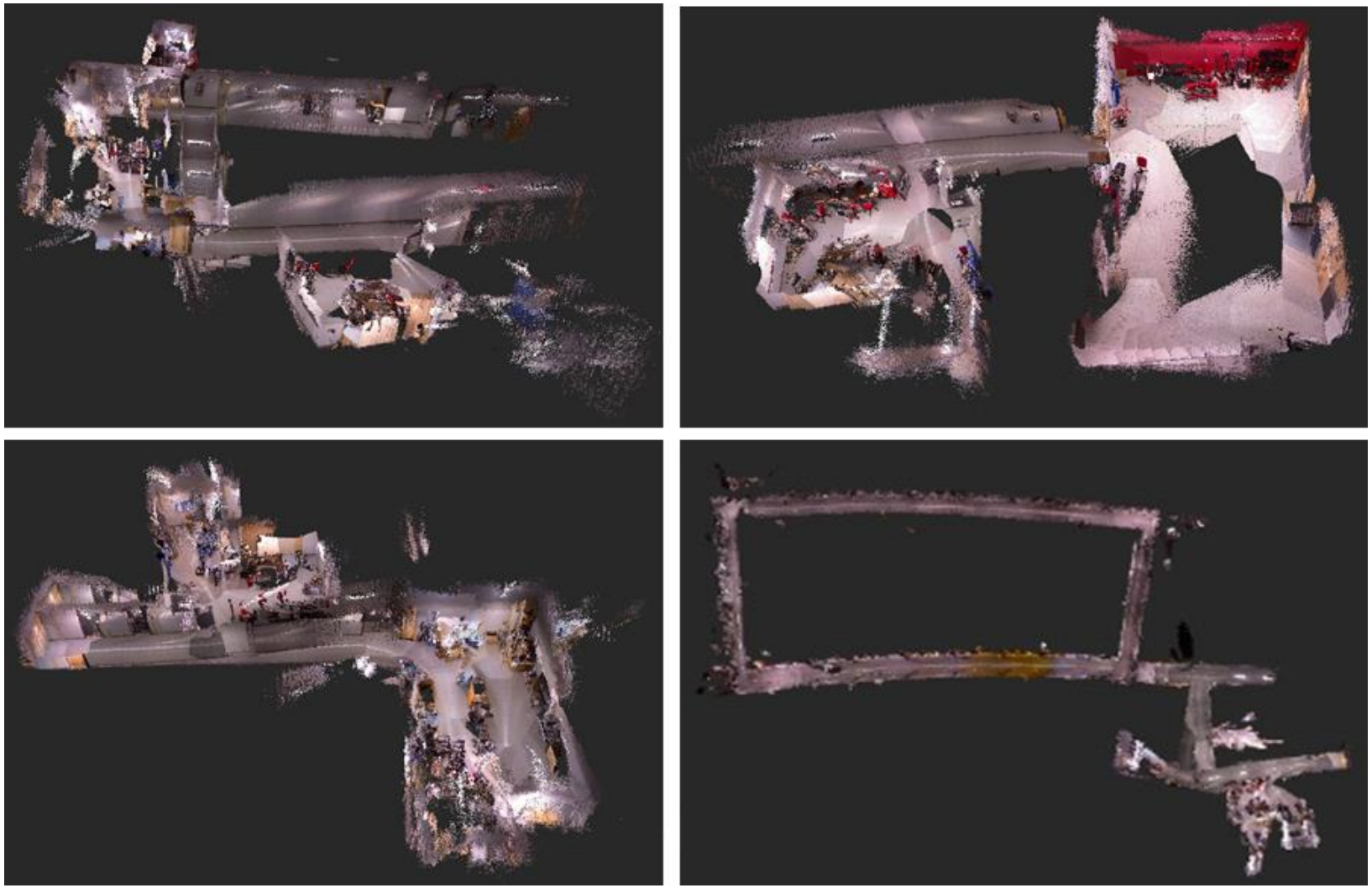
RTABMap Multi-Session Simulation



POINT CLOUDS

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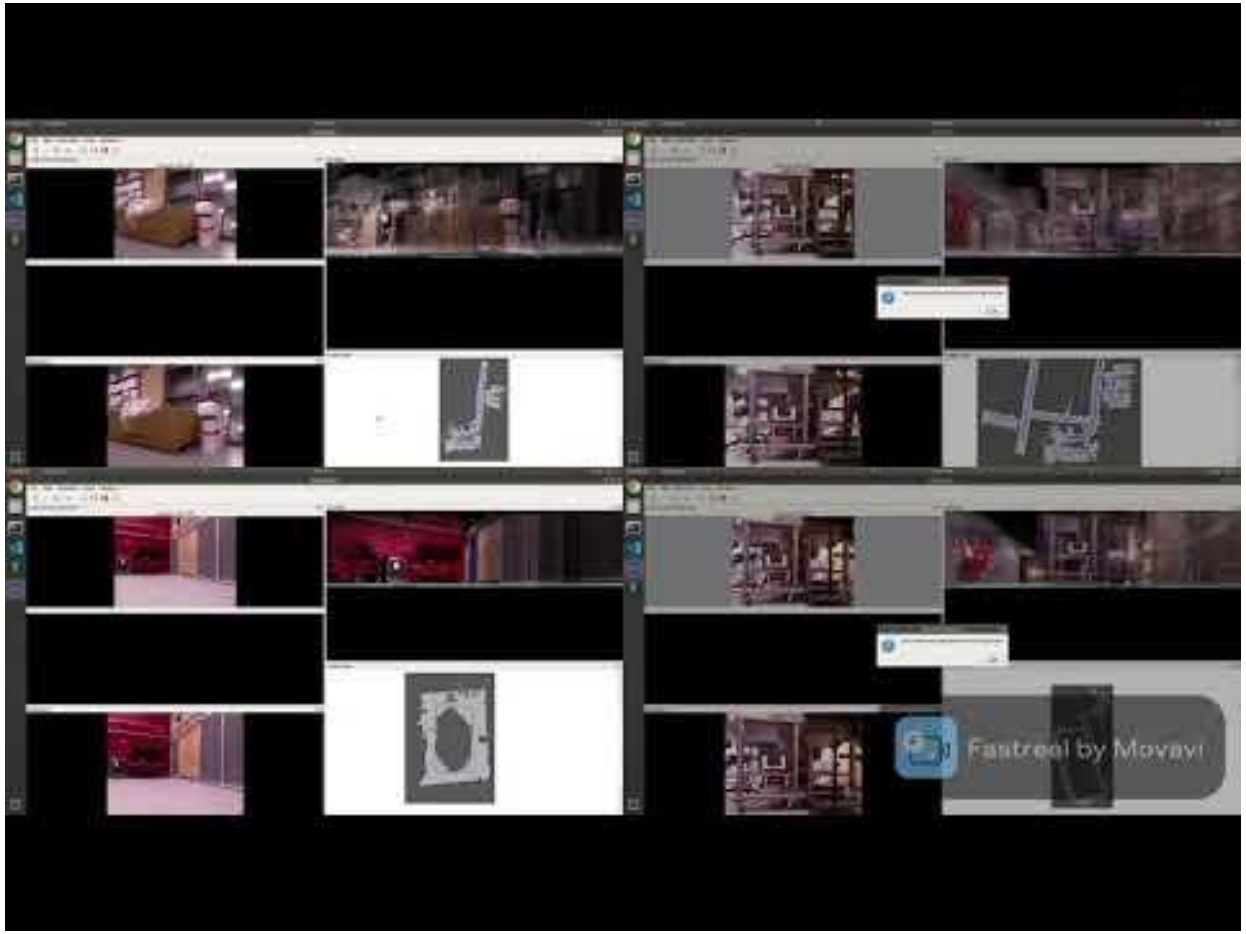
RTABMap Multi-Session Simulation



VISUALIZATION

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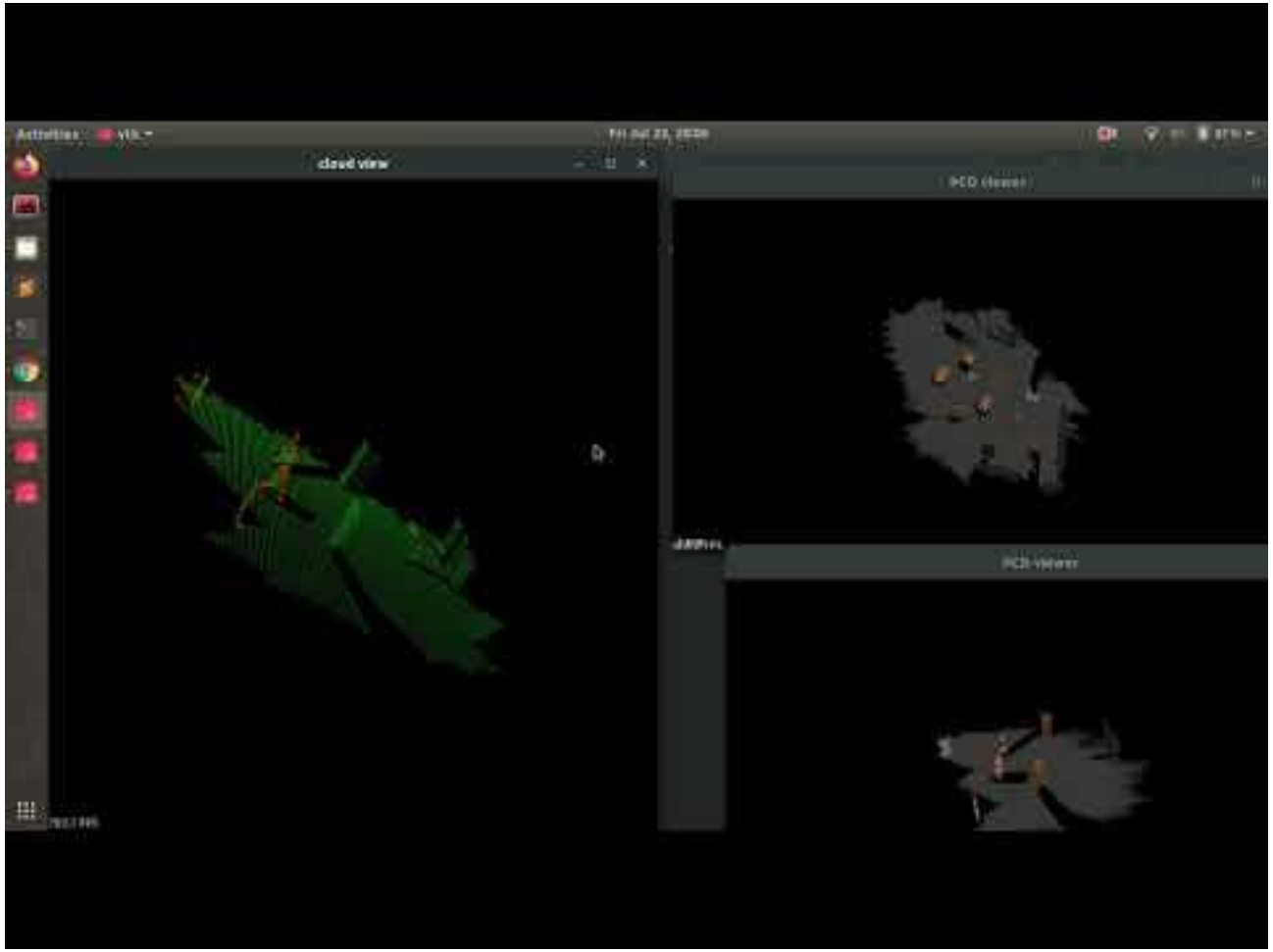
CUSTOM RTABMAP SIMULATION



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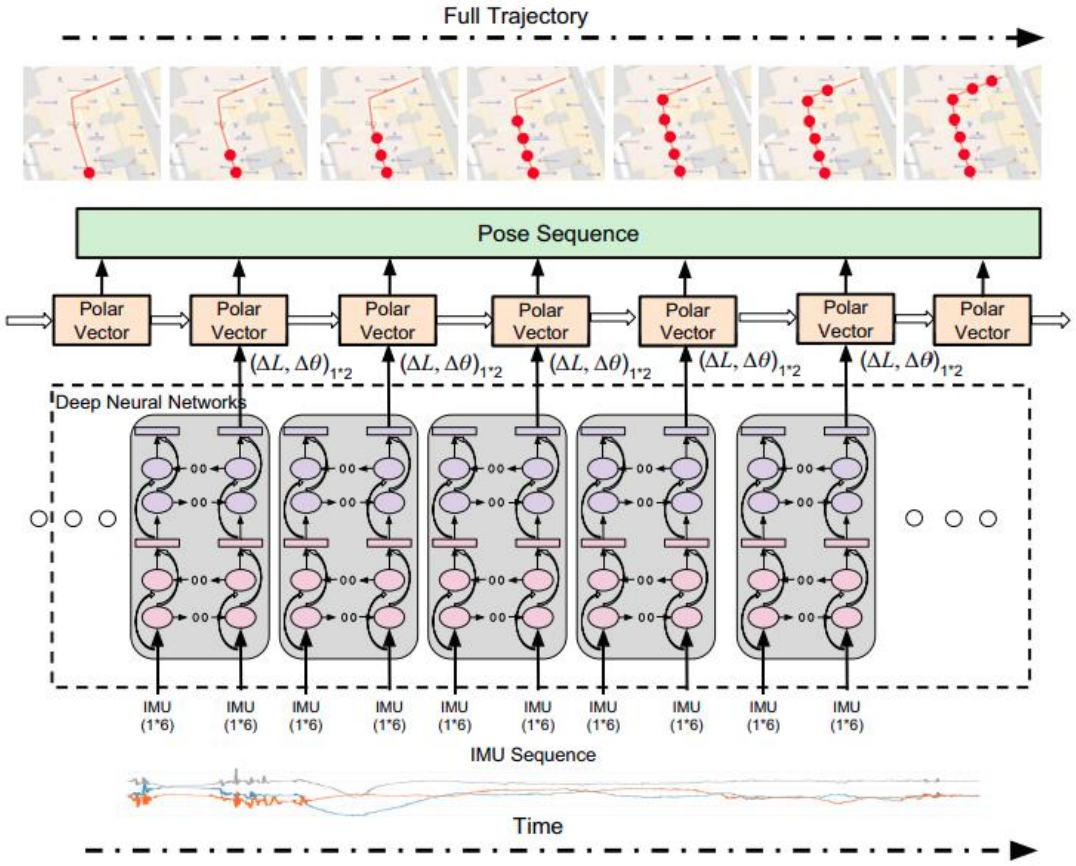
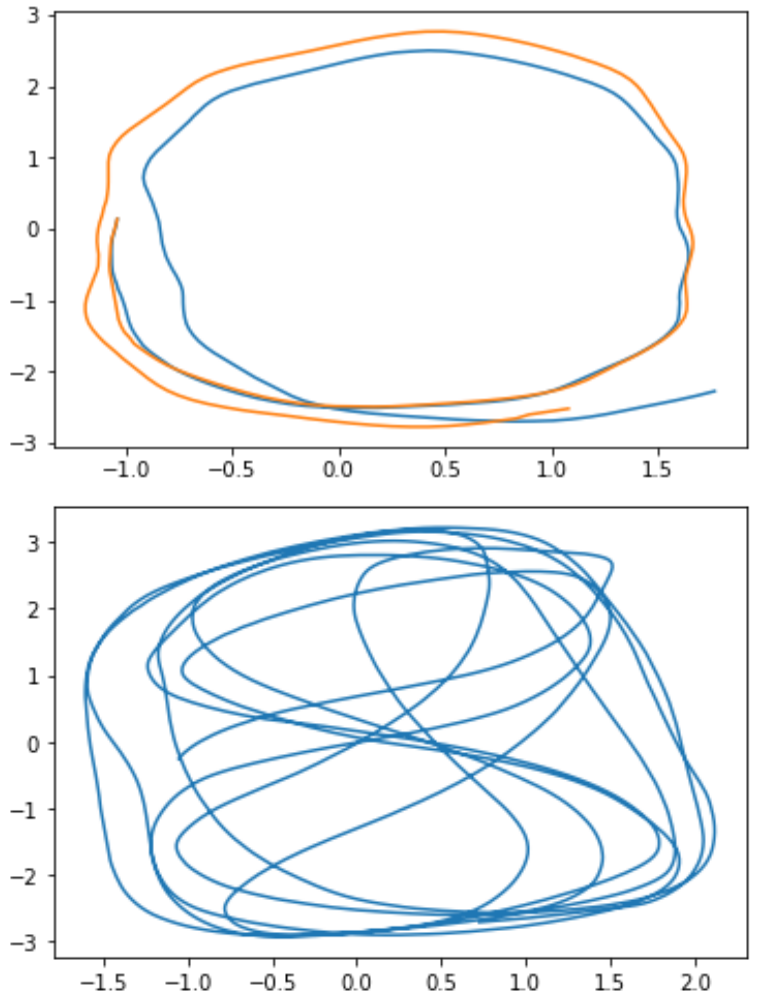
Off-beat experiments

1. OxIOD Dataset for improving inertial and visual-inertial odometry





Can be used for redundancy in cases of temporary feature-loss for lower drift

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Future Work

1. We develop a modular system for slam in dynamic environments, such that each part is modular and can be modified individually for better results. In the near future, we aim to perform comparative and ablation studies to test the best module and examine its robustness.

2. The segmentation model requires a pre-knowledge of the classes, we aim to develop a self-supervised/semi-supervised approach for segmenting dynamic objects coupled with optical flow information.

1. For multi-agent SLAM, we aim to also develop a system for feature matching and registration in low-overlap conditions, taking inspiration from PREDATOR.

2. Explore ways of knowledge distillation for reducing number of parameters and making the network faster.

3. Explore the possibilities of an E2E training fashion, something like gradSLAM.

4. How and When to update map? Lifelong SLAM vs Threshold based change.

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