3D MAPPING AND LOCALIZATION OF MOBILE ROBOTS

An application to UV-C disinfection robots

CHALLENGES: Health and wellbeing, smart and integrated transport

PRODUCTIVE SECTOR: Autonomous systems transforming ICT, robotics

PROBLEM DESCRIPTION

The industrial problem tackled in this project is the 3D mapping, accurate vision-based localization and position tracking of an UV-C disinfection robot, that can quantise the irradiance on the surrounding surfaces.

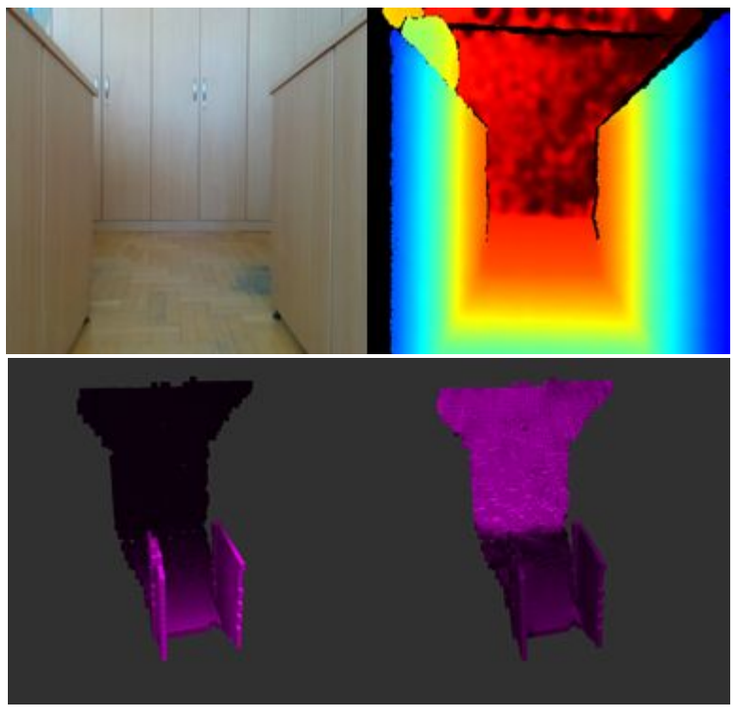
CHALLENGES AND GOALS

- To develop a 3D mapping algorithm using RGB-D sensors and to quantise the UV-C irradiance on the surrounding surfaces in near real time operation
- To investigate and develop a system to accurately localize a mono-camera equipped robot in 3D mesh models and point-clouds
- To perform fundamental research to speed up the algorithm for relative position estimation between consecutive robot positions

MATHEMATICAL AND COMPUTATIONAL METHODS

Irradiance depends on:

- Distance from the light source – Inverse Square Law: $I(r) = \frac{k}{r^2}$
- Angle of incidence – Lambert Cosine Law $I(\Theta) = I_{dir} \cdot cos(\Theta)$
- Time of irradiation



Top: Snapshot of the of the test environment RGB (left) and Depth (right) images

Bottom: Irradiance computed with respect to distance (left) and angle of incidence (right)

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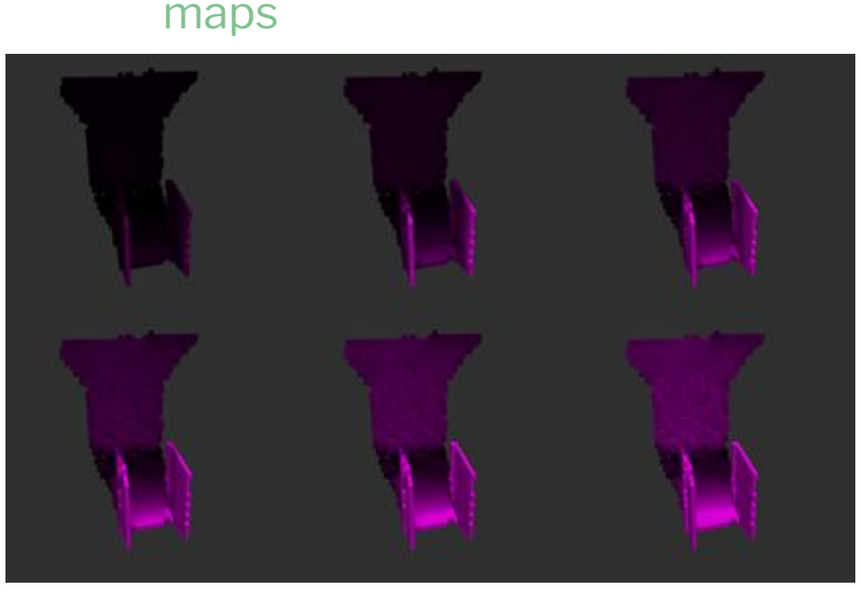
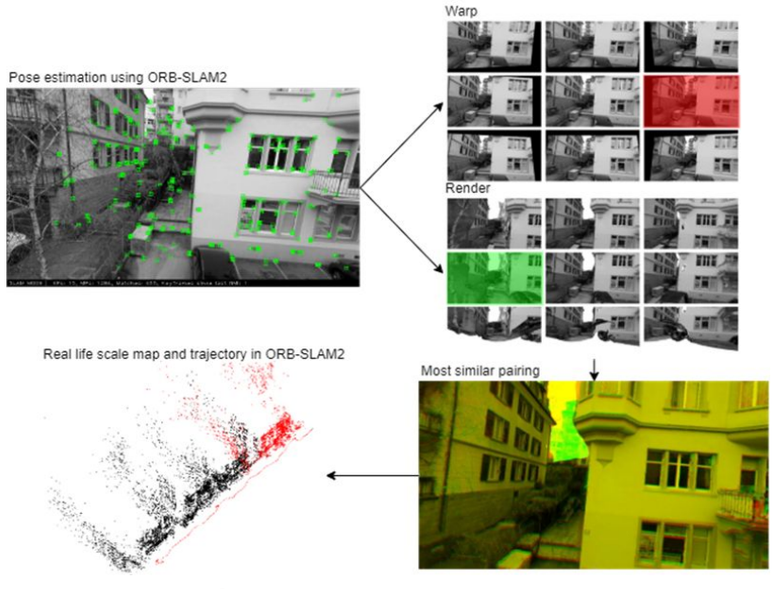
Results and Benefits

- Voxel based algorithm to reconstruction of the environment
- New method to solve the relative pose between two robot positions from deep learned depth and a single affine correspondence
- Accurate appearance-based mono camera localization system in 3D maps



Dynamic simulation of irradiation computed from both distance and angle of incidence over time



Overview of the proposed localization algorithm (applied in outdoor environments to localize an MAV)

Intelligent 3D irradiance estimation in near real time operation

Accurate and fast mobile robot localization

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