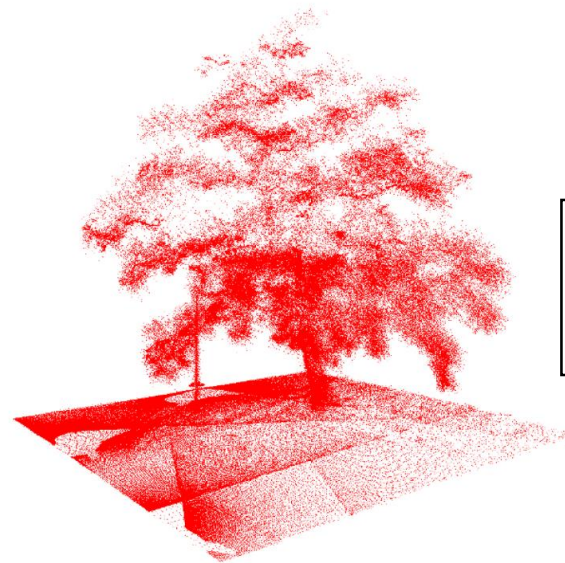# Super Ray based Updates for Occupancy Maps

Youngsun Kwon, Donghyuk Kim, and Sung-eui Yoon

KAIST, South Korea
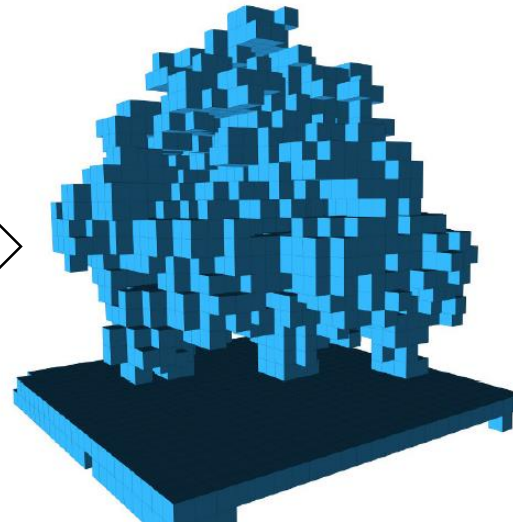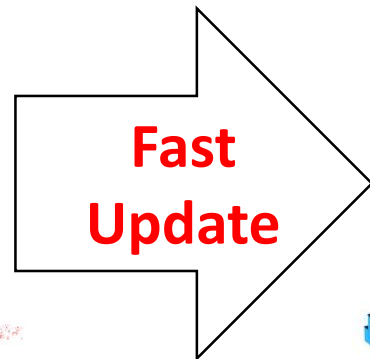
Motivation
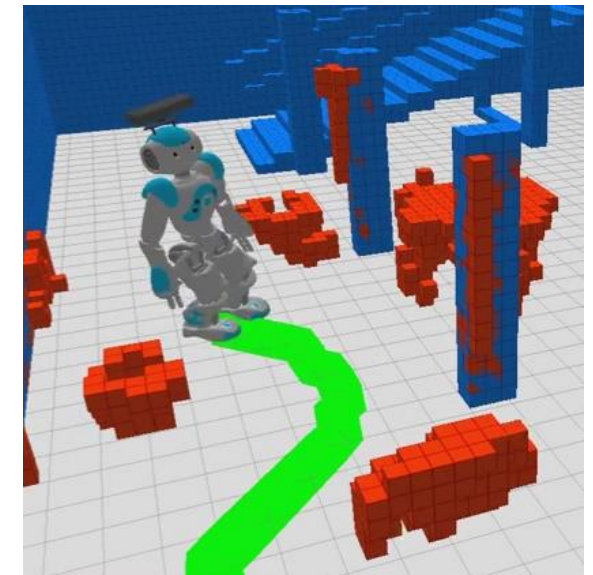
- **It is essential to update map representation fast**

    - A robot should react to dynamic environment in real time

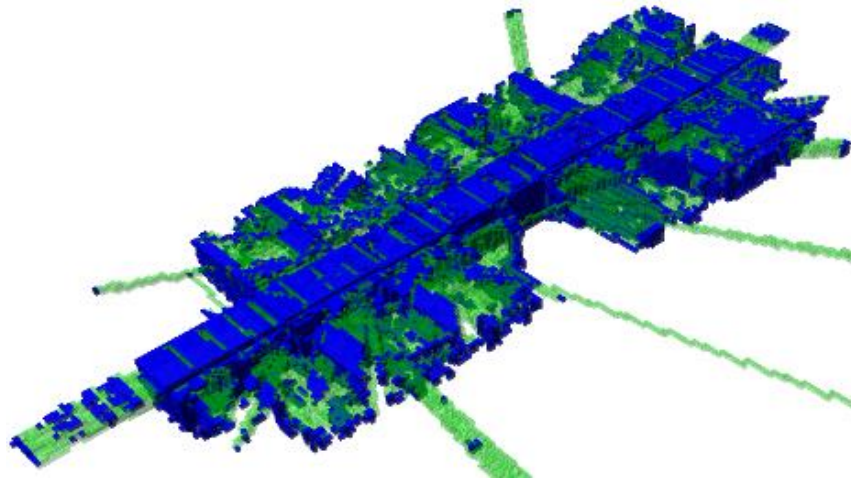Point clouds   Fast Update   Map representation (grids or octrees)   Applications: e.g. Motion Planning

Wurm et al., "OctoMap: A probabilistic, flexible, and compact 3D map representation for robotic systems", ICRA 2010

Research Goal

- **Accelerate update speed of map representation**

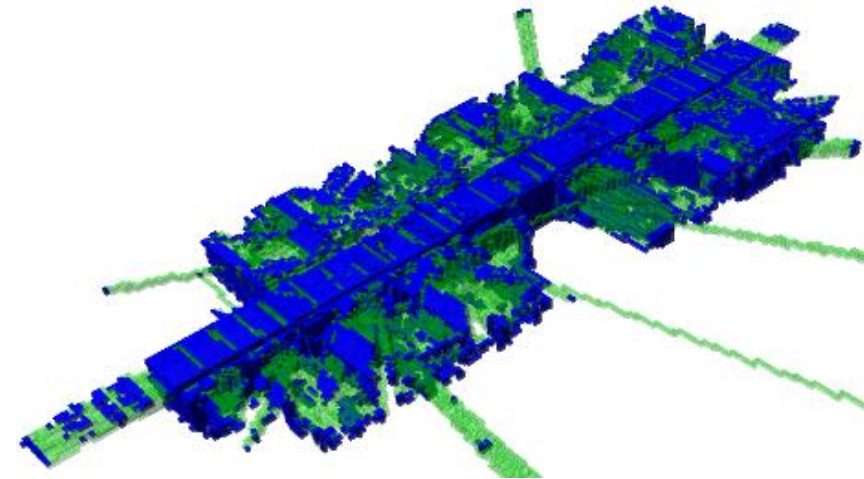 **without degrading representation accuracy**

Prior work (3DDDA)

Ours

0.2m resolution

0.2m resolution

7.3 FPS

12.1 FPS

J. Amanatides et al., *Eurographics, 1987*
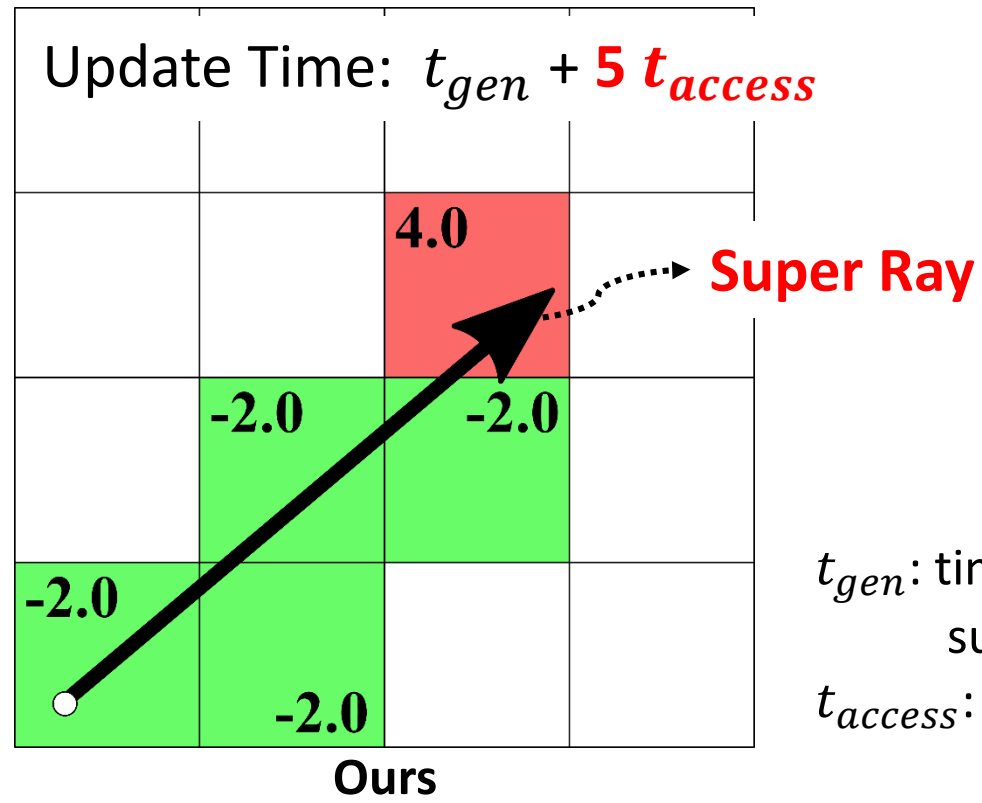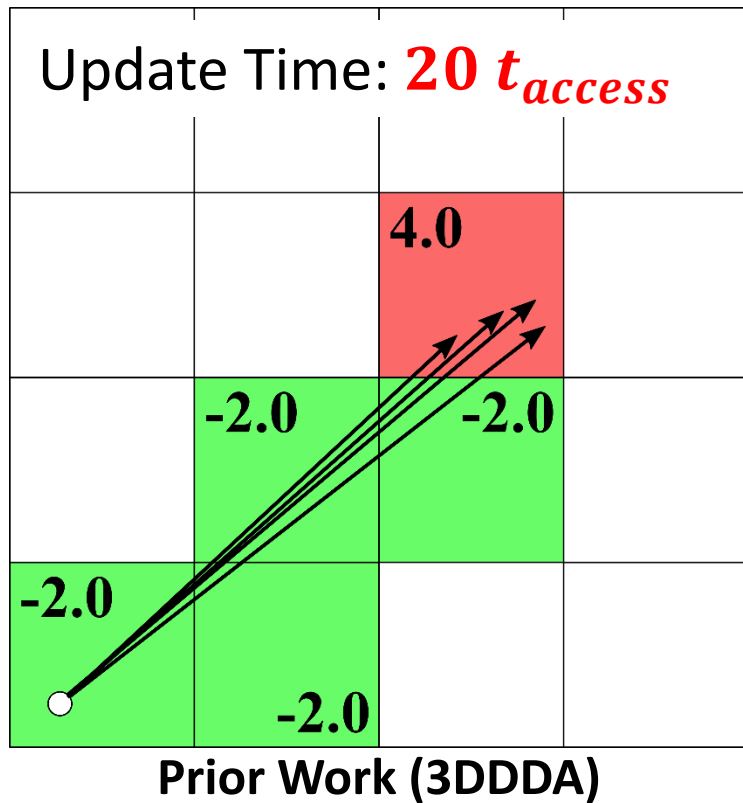
# Basic Idea of Our Approach

- **Propose a novel concept: Super Ray**

  - A representative ray for set of points that traverse the same cells

  - Reduce the number of accesses for cells to be updated

Update Time: $20\ t_{access}$

Update Time: $t_{gen} +$ $5\ t_{access}$

4.0

4.0

Super Ray

-2.0   -2.0

-2.0   -2.0

-2.0

-2.0

-2.0

-2.0

Prior Work (3DDDA)

Ours

t_{gen}: time to generate
super rays
t_{access}: time to access
a cell to be updated

Basic Idea of Our Approach

- **Generate super rays from point clouds efficiently**

  - Key observation: traversal patterns of cells differ along **grid points**

  - Classify point clouds into set of points with the same traversal pattern
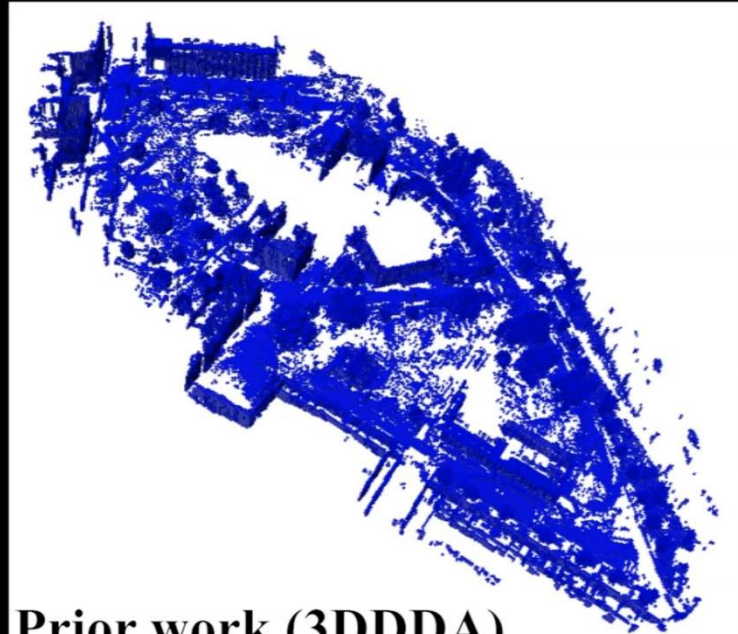
  - Available in both 2-D and 3-D
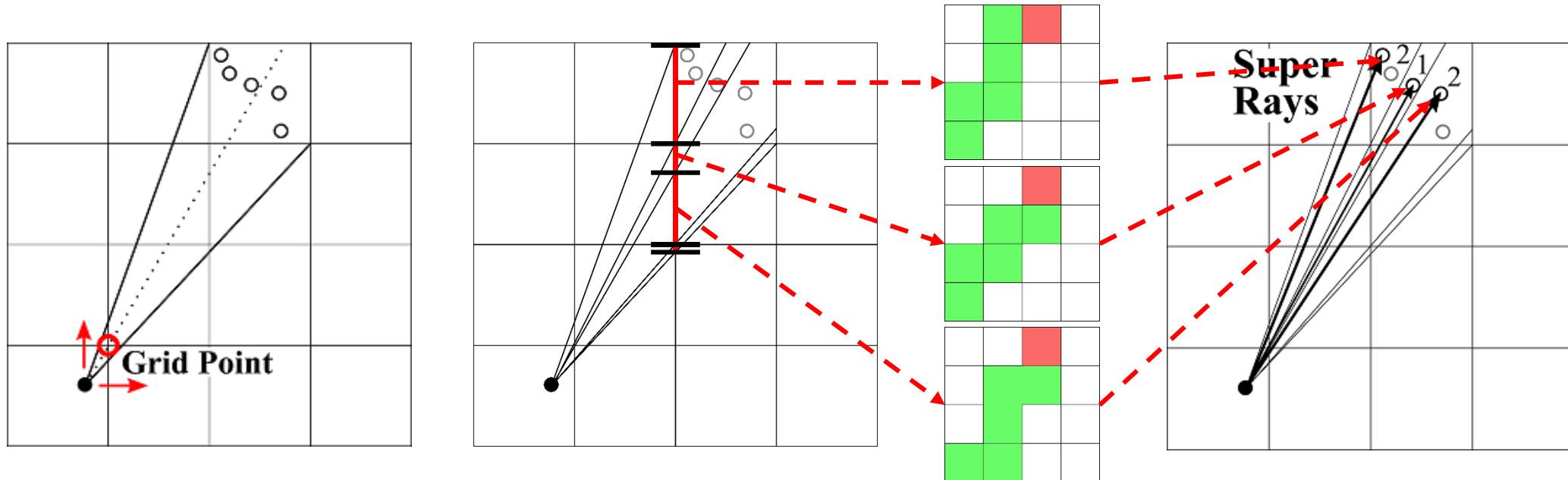
Main Result – Outdoor Scene
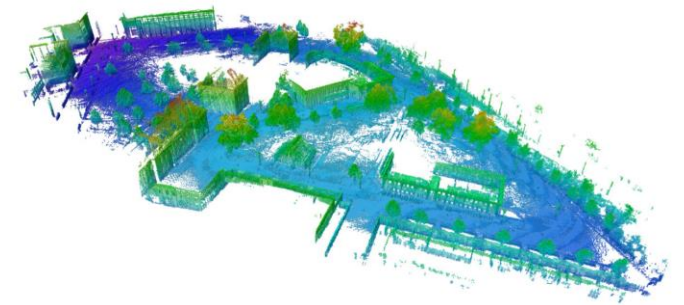
- **Source code is available at** http://sglab.kaist.ac.kr/projects/SuperRay

- **Enable 1.5 times on average performance improvement**
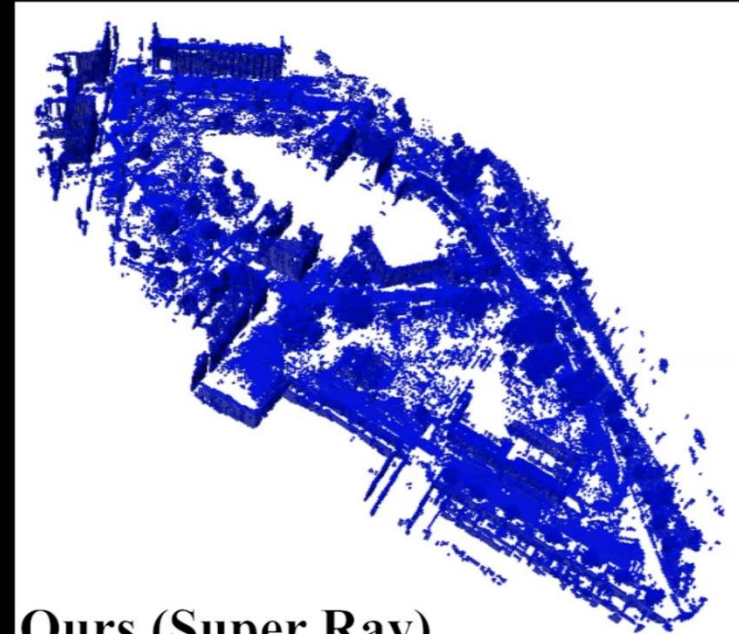

Outdoor Dataset (0.6m resolution, OctoMap)

Time [s]: 33.444 — Prior work (3DDDA)

Time [s]: 22.919 — Ours (Super Ray)