ETH zürich

Autonomous Systems Lab

LiDAR and RGB-D Sensors in Mobile Robotics

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LiDAR and RGB-D in Robotics

- Different environments
  - Indoor
  - Outdoor
  - Overhead
- Different robots
  - Fixed and rotary wing
  - Wheeled and tracked
  - Legged
- Different scales
  - RC car scale
  - Full sized car
  - Open pit mine trucks

Abandoning Sonars

- 2D sensors for safety purposes
- Cost between USD 3k and USD 10k
- Triggered development of SLAM
- DARPA 2004 and 2005 Grand Challenge

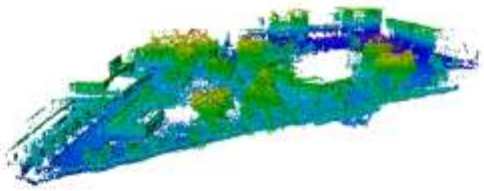
Stanley from Stanford Racing Team

SICK LMS-200

Hokuyo UTM-30LX

Adding a dimension

- Inspection and monitoring devices
- Cost between USD 10k and USD 75k
- Efficient map representations
- Used everywhere from self-driving vehicles to small indoor robots



OctoMap: An Efficient Probabilistic 3D Mapping Framework Based on Octrees

Waymo One

EUROPA robot

Velodyne HDL-64E

Velodyne VLP-16

Color and Distance

- Low-cost device
- Aligned depth and color data
- High data rate and density
- Detailed object reconstruction

Kinectfusion: Real-time dense surface mapping and tracking

Microsoft Kinect for Xbox 360

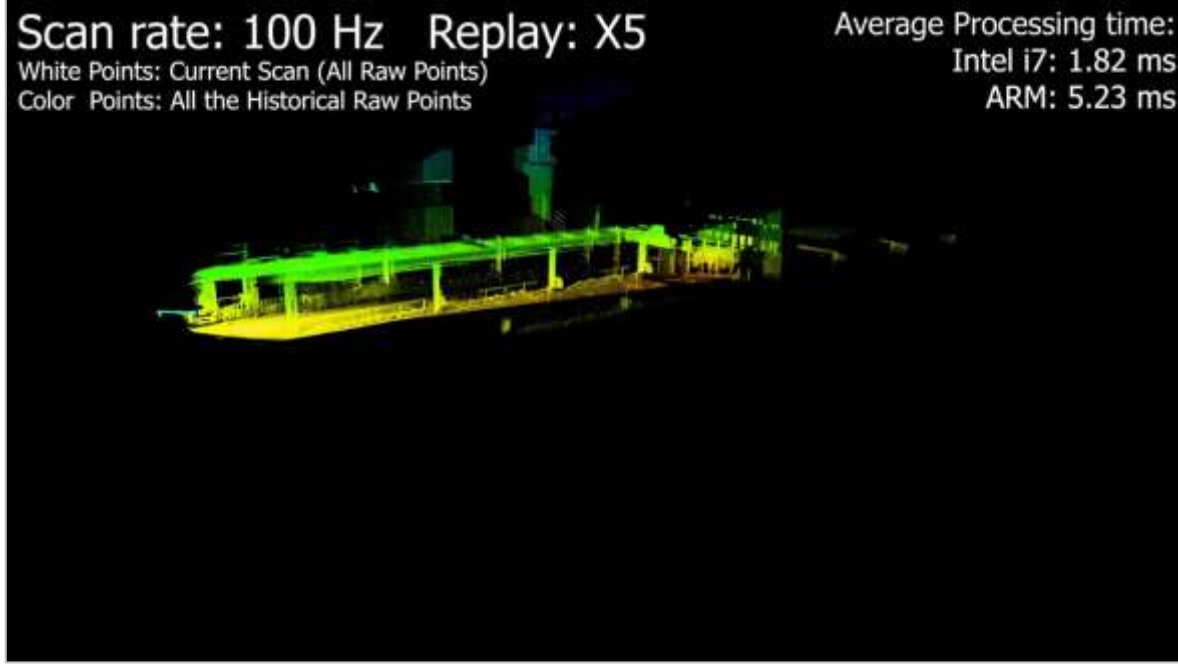
Microsoft Azure Kinect

Intel Realsense D435

Voxblox: Incremental 3d euclidean signed distance fields for on-board mav planning

Refinements

- Cheaper devices
- More observations
- Smaller form-factor
- Sensor-fusion becoming a requirement
- Improve efficiency and accuracy of algorithms



Fast-lio2: Fast direct lidar-inertial odometry

Efficient volumetric mapping of multi-scale environments using wavelet-based compression

Research Challenges

- Large scale
- Fine detail
- Complex geometry
- Reflective surfaces

Conclusion

- Increase in sensor capabilities
- More accessible and improved capabilities
- Facilitated and pushed research

- Variable scan pattern
- Dimensionally accurate
- Suitable for dynamic environment and fast motions

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