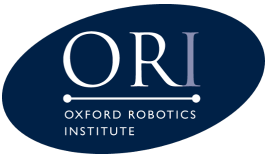
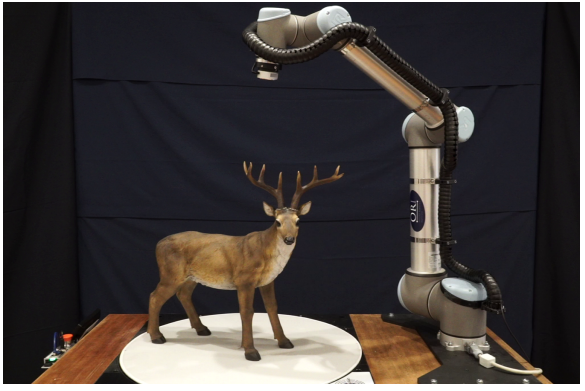


Towards Autonomous Aerial Mapping for Emergency Response

Rowan Border
Estimation, Search, and Planning (ESP) Research Group
Oxford Robotics Institute (ORI)
University of Oxford
2022-03-16

Capturing Scene Observations

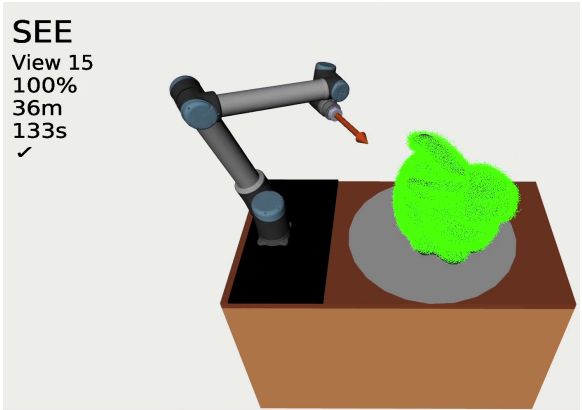


Mapping small-scale objects

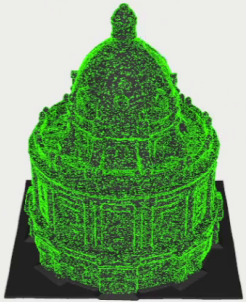
Inspecting large-scale structures

Planning Next Best Views

- Choosing where to view a scene from
  - next in order to obtain the
  - best improvement from the selected
  - view is known as
  - **Next Best View (NBV) Planning**
- The **Surface Edge Explorer (SEE)** is a measurement-direct NBV approach that can efficiently plan views to capture the greatest coverage while incurring the lowest observation cost

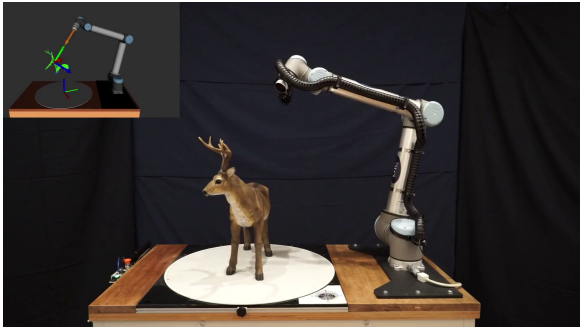


SEE
View 36
98%
937m
928s
✔



Real World Experiments

- Real world experiments were performed with a physical robot platform
- The platform consists of
  - a UR10 robot arm
  - a rotating turntable
  - an Intel RealSense L515
- SEE was used to observed a deer statue placed on the rotating turntable



Aerial Mapping System

- Developed in collaboration with the DRS research group at ORI
- The platform consists of a Frontier sensor system mounted underneath a DJI M600 hexrotor drone
- The Frontier is comprised of
  - an Ouster OS1-64 LiDAR + IMU
  - an Intel RealSense D435i + IMU
  - an Intel NUC

Photograph courtesy of DRS

Aerial Mapping System

- Sensor measurements are captured by an Ouster OS1-64 LiDAR
- Localisation will be provided by the VILENS odometry system from DRS
- View planning will be performed by SEE
- The drone will initially be manually flown between views for safety reasons
- When autonomous flying is deemed safe, paths between views will be planned by the AIT* algorithm from ESP

Photograph courtesy of DRS

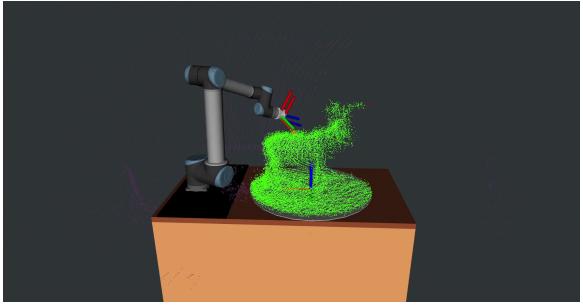
UNIVERSITY OF OXFORD

ORI OXFORD ROBOTICS INSTITUTE

ESP

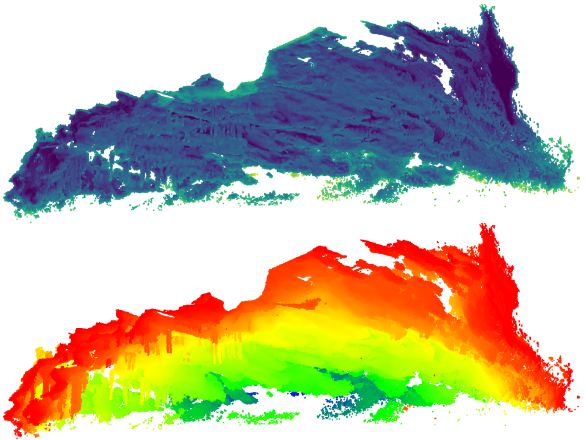
Intermediate Experiments

- Performed experiments with the UR10 platform but replaced the Intel RealSense L515 with an Ouster OS1-64
- Used VILENS for localisation instead of the UR10 kinematic chain
- SEE is still able to obtain a complete observation of the deer statue despite the sensor noise



Intermediate Experiments

- Captured 3D maps of natural cave formations with an Intel RealSense L515
- Used VILENS for localisation
- Observation was human-directed so did not use SEE for view planning or AIT* for path planning



Future Experiments

Godstow Abbey, Oxford

Fire Service College, Moreton-in-Marsh

Thank you