Reliability-Enhanced Robots with Map-based Teleoperation and Semi-Autonomous Capabilities
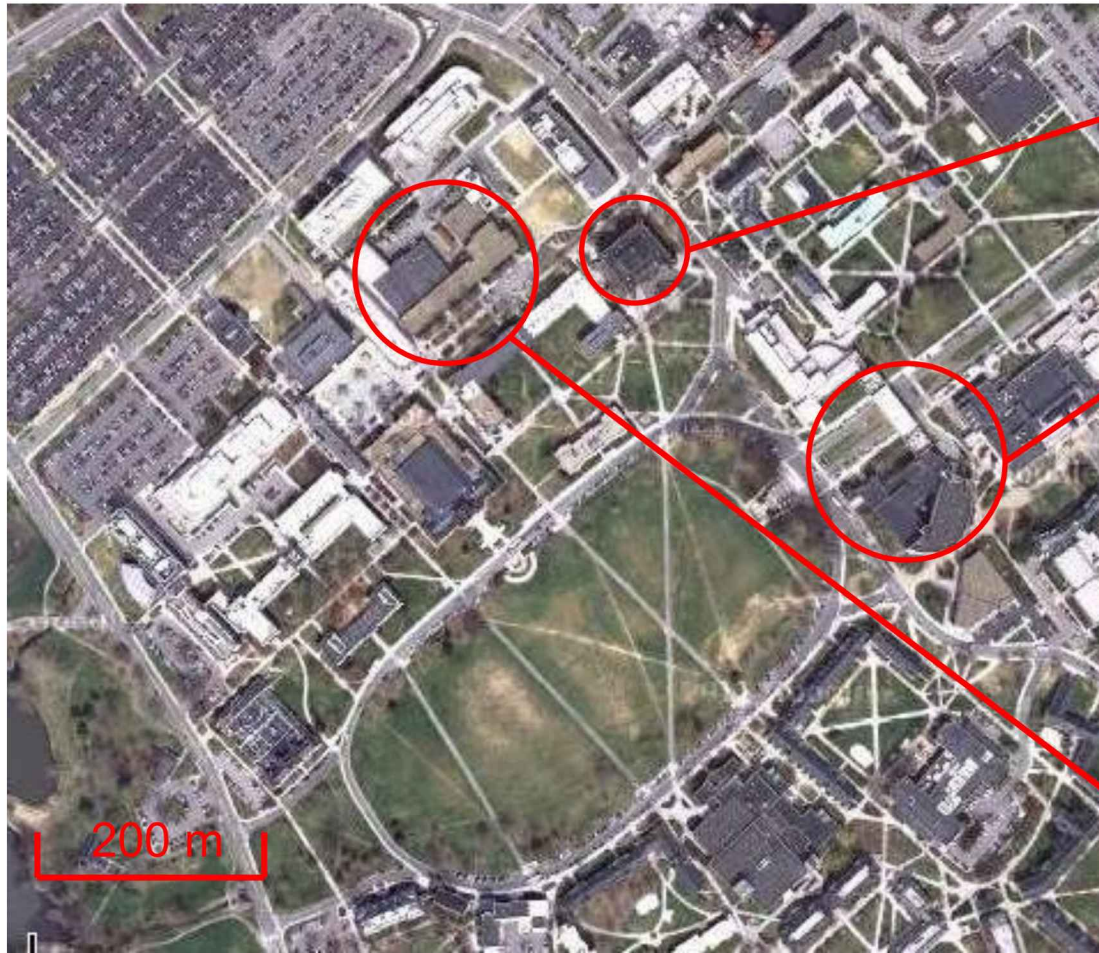
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Computational
Multiphysics
Systems Lab

CMS

VirginiaTech

200 m

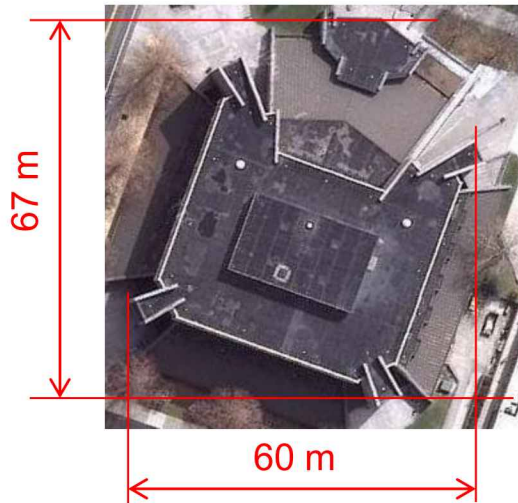Virginia Tech campus (Blacksburg, VA)

McBryde Hall

Newman Library

Challenge:
- Large (100m x 100m)
- Complex (Rooms/corridors)
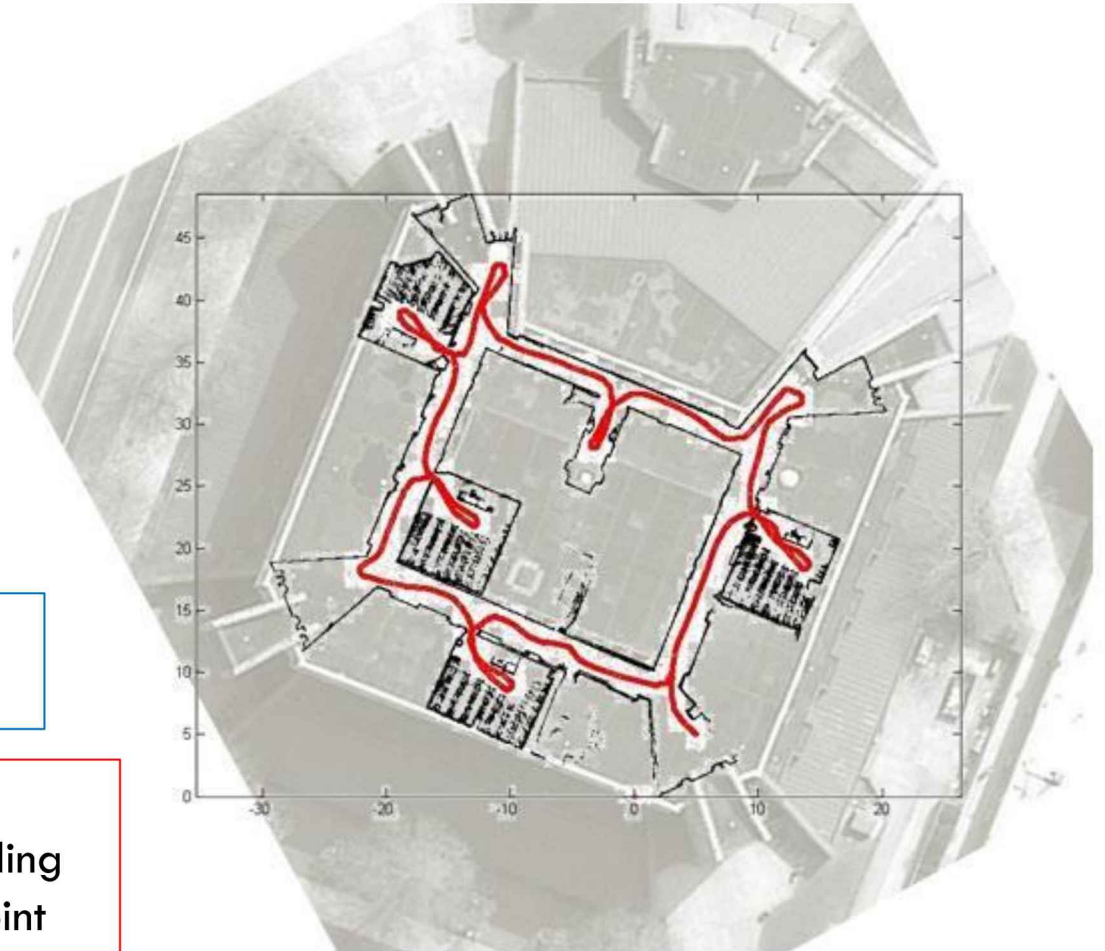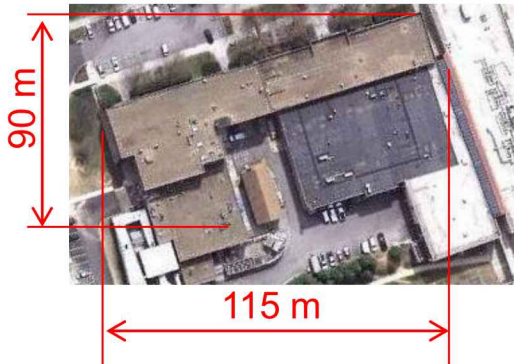- Practical (Existing bldgs)
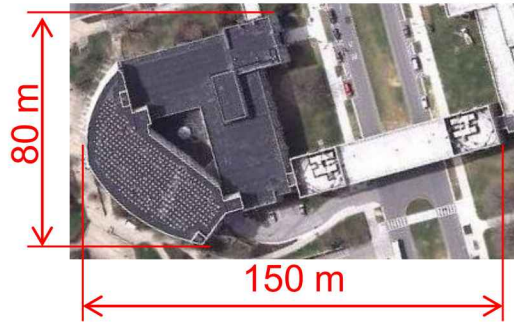
Randolph Hall

Result at McBryde Hall

67 m

60 m

Challenge:
Long loop corridor (120m)

Result:
10cm/0.5deg error after traveling
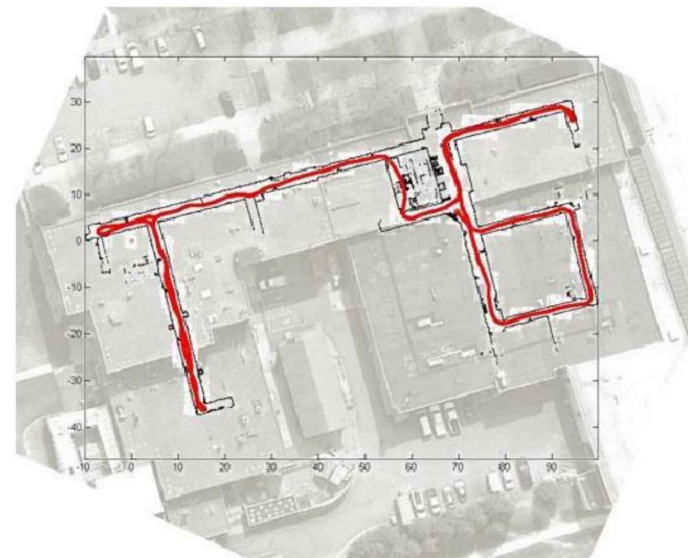235m without revisiting start point

Results at Two Other Buildings
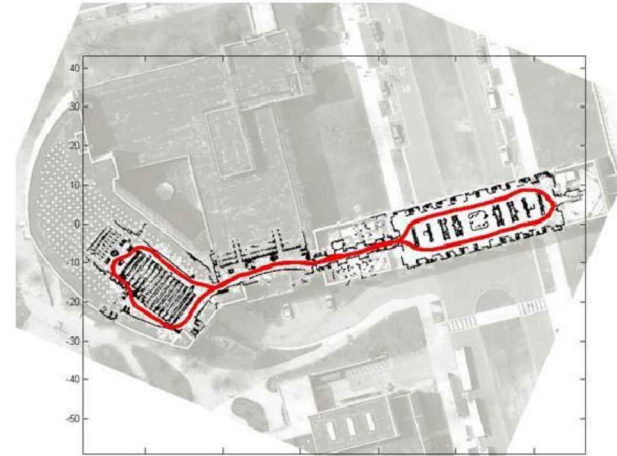

80 m

150 m

90 m

115 m

Challenge:
- Larger areas (100m x 100m)
- Long open-loop corridors

Result: 5cm/0.5deg error

Fukushima power plants
- GPS-denied
- Dark
- Humid
- Unreliable communication (1m wall thickness)

Issues of robot use:
- Two weeks training
- Camera may not be usable
- Wires could get jammed

Immediate use of robotics technology:
- Map-based teleoperation in camera/GPS-denied environments
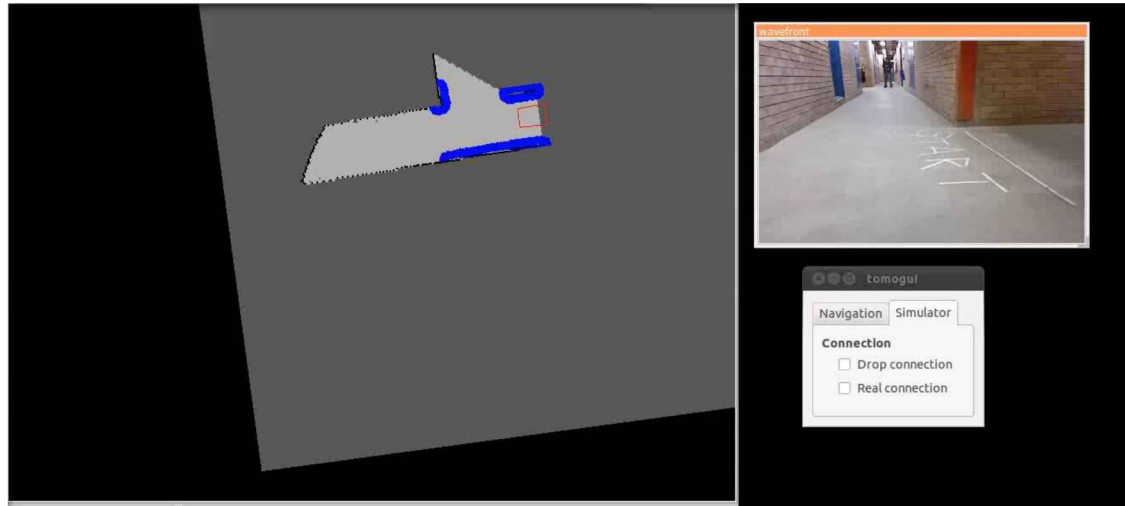- Semi-autonomous return in communication denied environments

Packbot in Fukushima power plant
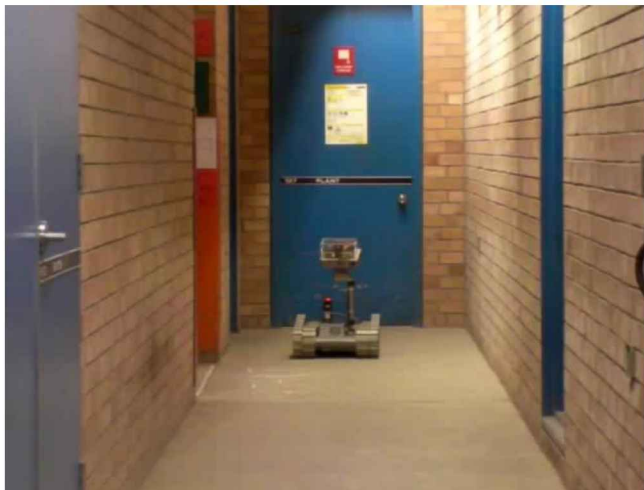(source : Reuters/TEPCO)

Returning to starting position

CMS Lab
Virginia Tech

GUI for map-based teleoperation
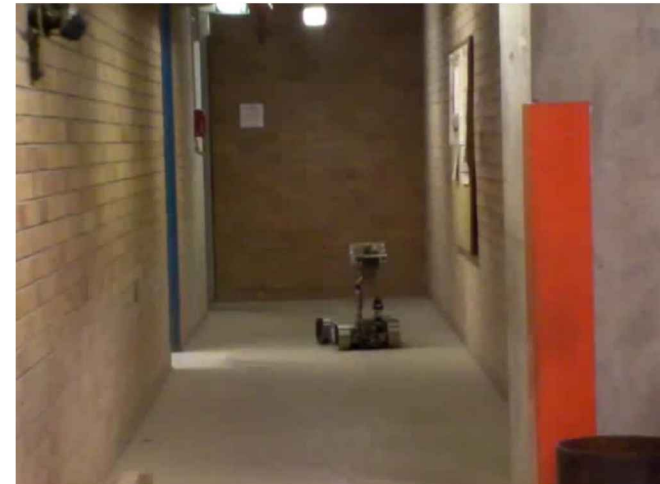

Map-based teleoperation

Semi-autonomous return

Conclusions

Reliability-enhanced robots

- Use of robot in use at Fukushima power plant
- Use of accurate Simultaneous Localization and Mapping
  - Grid-based Scan-to-Map Matching SLAM
  - Map accuracy with less than 0.01% error

Semi-autonomous robots for nuclear power plants

- Map-based teleoperation in GPS-/camera-denied environments
- Semi-autonomous return under communication loss

Further achieved work

- 3D road inspection
- 3D bridge inspection