

GVSC Robotics Planning Discussion

Carnegie Mellon University
Software Engineering Institute
Emerging Technologies Center

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Carnegie Mellon University

- 1,442 total Faculty
- 13,285 Students
- 130 Research Centers
- Locations in Pittsburgh, PA, Silicon Valley, CA, and Doha, Qatar
- Rankings:
 - #17 University overall in US
 - #1 for Computer Science
 - #4 for College of Engineering



Carnegie Mellon University

Software Engineering Institute

- Founded in 1984 as a Federally Funded Research and Development Center
- ~700 total employees
- Headquarters in Pittsburgh, PA, but with offices in Washington, DC and California
- Divisions
 - CERT
 - Software Solutions Division
 - Emerging Technology Center



CARNEGIE MELLON UNIVERSITY
SOFTWARE ENGINEERING INSTITUTE

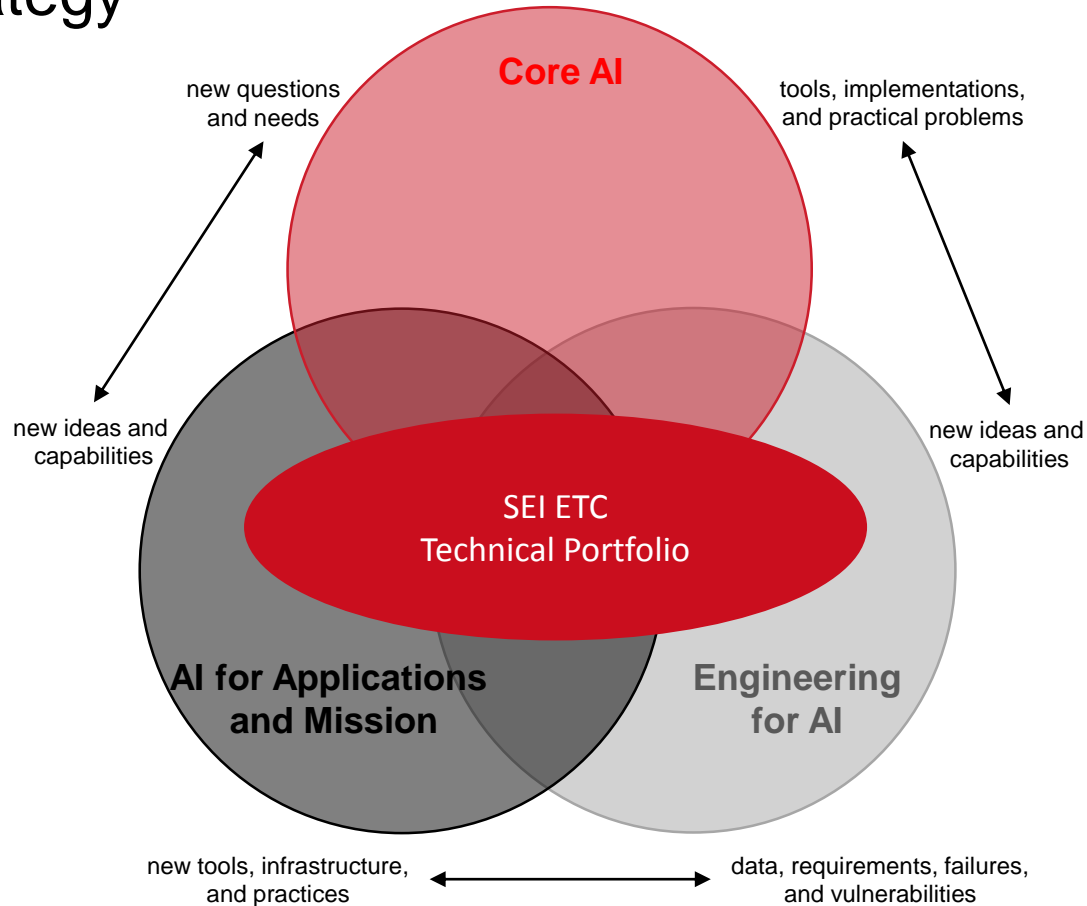
SEI Emerging Technology Center: Making the Recently Possible Mission-Practical

Applied Artificial Intelligence
and Machine Learning

Advanced
Computing

Human-Machine
Interaction

SEI AI Strategy

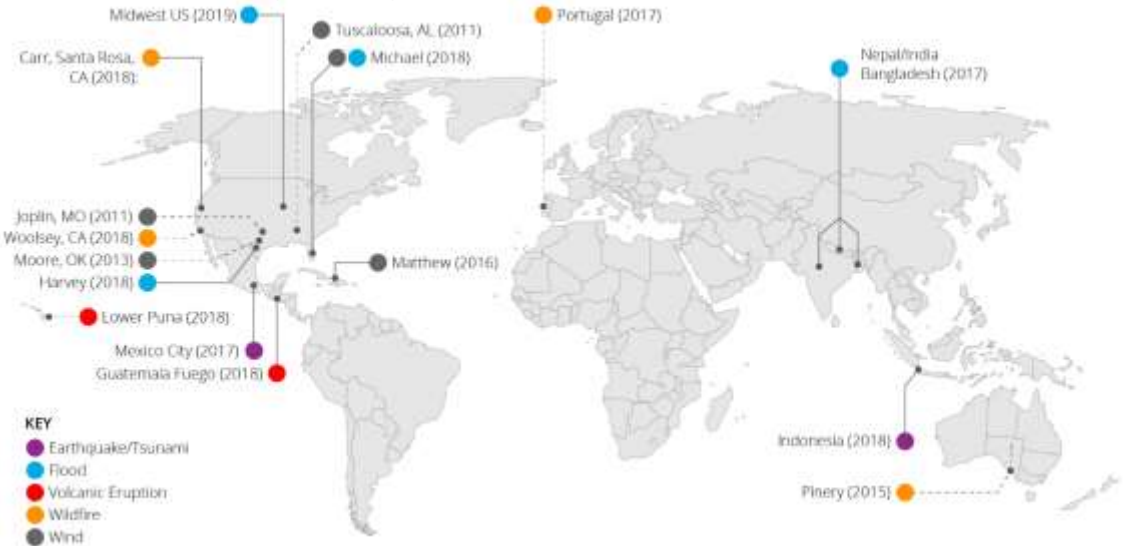


CMU-ETC Collaborations



xView2 Challenge: Automating the Process of Assessing Building Damage After a Natural Disaster

- Dataset includes:
 - 6 disaster types across 15 countries
 - 850,736 buildings/structures
 - 45,361 square kilometers
- Joint Damage Scale to assess building damage



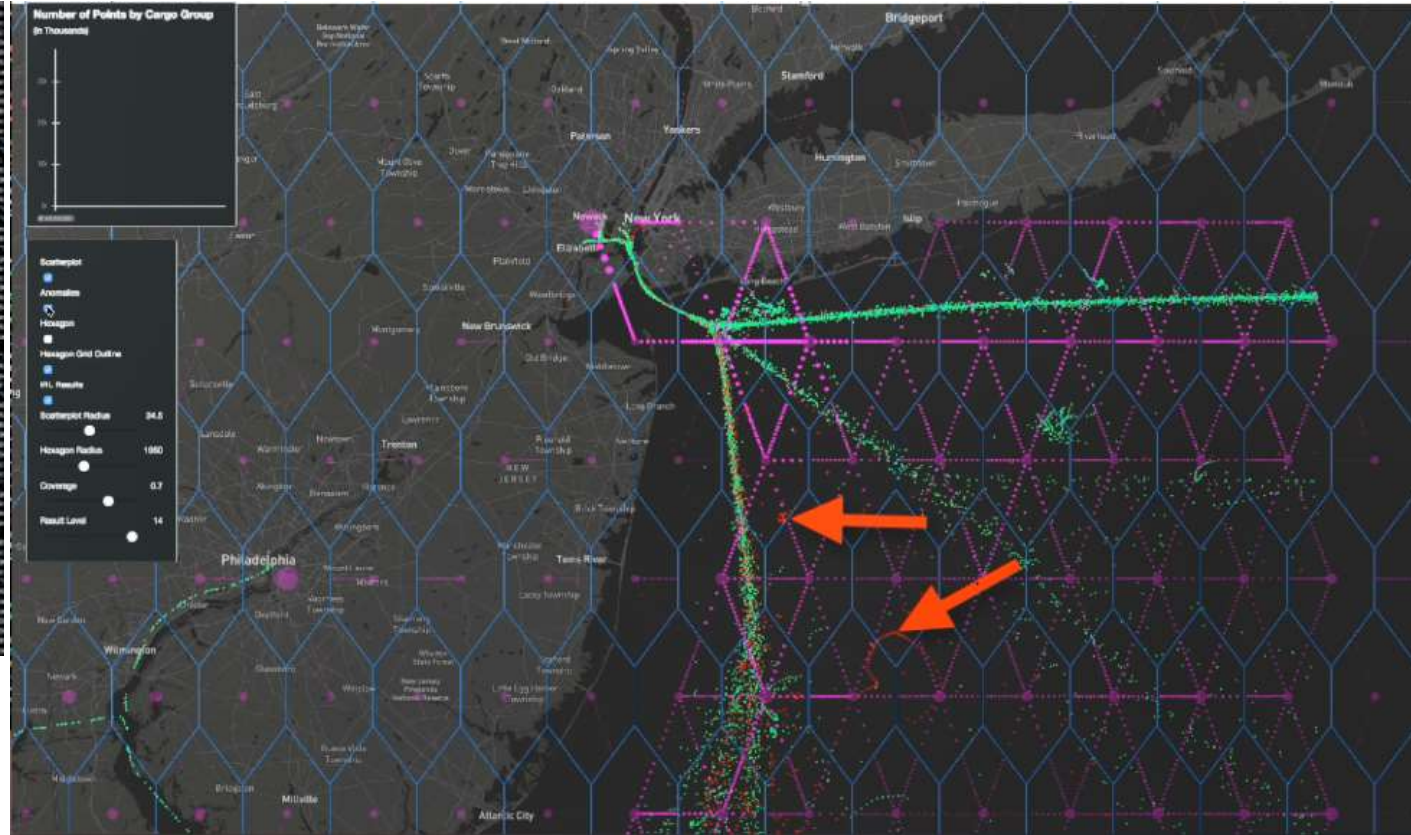
Disaster Level	Structure Description
0 (No Damage)	Undisturbed. No sign of water, structural or shingle damage, or burn marks.
1 (Minor Damage)	Building partially burnt, water surrounding structure, volcanic flow nearby, roof elements missing, or visible cracks.
2 (Major Damage)	Partial wall or roof collapse, encroaching volcanic flow, or surrounded by water/mud.
3 (Destroyed)	Scorched, completely collapsed, partially/completely covered with water/mud, or otherwise no longer present.



Identifying Anomalous Behavior via Inverse Reinforcement Learning



U.S. Coast Guard data



Cyber Table Top (11/4 – 11/6 @ Detroit Arsenal)

- Study the behavior of RTK / MRZR in a real-world scenario
- OPFOR (Red) team theoretically attacks the OPS (Blue) team, which evaluates the results of the attack
- Develop threat model
- Prioritize attack vectors highlighted during the exercise
- Use results to inform IDS/IPS research moving forward
- Learn the most effective processes and techniques for a CTT exercise
- Follow up with additional CTT exercises using lessons from the previous

IPS/Anomaly Detection

- Software prototyping and simulation
 - AI/ML techniques to enhance autonomous operation
 - Includes documentation and test procedures
- Publish research in conjunction with CCDC GVSC
 - Joint effort with Carnegie Mellon faculty
- Areas of interest:
 - Extend anomaly detection to continuous state space (rather than just grid world)
 - On-the-fly anomaly detection (rather than discovering through complete log traces)
 - Anomalies in multi-agent (i.e. distributed) robotic systems
 - Prioritizing robotic system data for input into IDS/IPS

RTK

- Add AI/ML features to aid in autonomous operation
 - Object detection
 - Multimodal sensing (sensor fusion)
 - Less uncertainty in results
 - More robust failure modes
- Port RTK to ROS 2
 - ROS 2 more standards-based (e.g. Data Distribution Service, DDS)
 - More flexible, reliable
 - DDS widely-used in mission-critical systems
 - ROS 2 still in development, in flux
 - Develop best practices for developing / deploying ROS 2 nodes

Other Areas to Explore

- How can humans trust the results of an autonomous system?
 - How did it arrive at those results?
- How do we arrive at an “anomaly decision?”
 - Standard methods arrive at an opaque “YES” or “NO” decision
- Need to be able to interpret reasons for decisions
 - Understand why a decision was made (less of a black box)
- Human in the loop
 - Develop human trust of AI systems
- Especially important for fast-paced warfighting situations