USC Robotics Research Labs
Director: Maja J Mataric
Associate Director: Gaurav S. Sukhatme
Founder: George A. Bekey
http://www-robotics.usc.edu

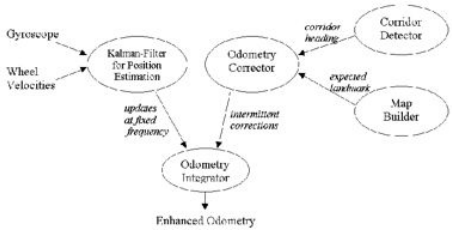
Distributed, real-time topological mapping with a heterogeneous group of mobile robots

Research Objectives

Our research addresses the development of algorithms for distributed, anytime, topological map building that can efficiently scale to groups of heterogeneous mobile robots. For this aim, robot behaviors have been devised to enable autonomous and safe navigation in unknown, indoor environments while evaluating and registering its features into a map.

Concurrent Mapping and Relocalization

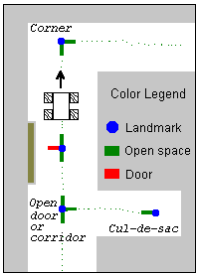
Since the robots start with no *a priori* given map, the position tracking capability bootstraps the mapping process by distinguishing between neighboring landmarks. Topological relocalization, on the other hand, refers to the partial map at hand to keep the position estimation errors bounded.

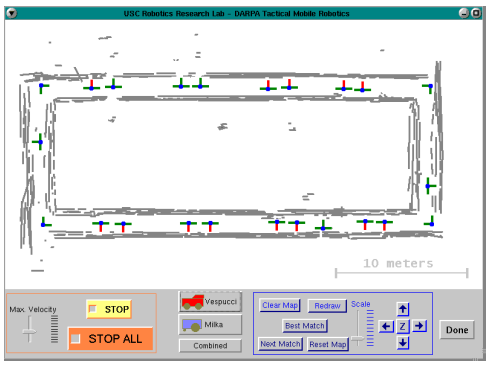


For enhancing the robot's odometry for indoor environments, the orthogonal corridors assumption was made, which required detected corridor stretches to be straight, and make right angles with each other.

Topological maps

Environmental features chosen as landmarks include open/closed doors, junctions, corners, and end-of-corridors. They represent the nodes of a topological map, also augmented with metric data. As the robots explore the environment autonomously and build their map, the graphical user interface is updated in real-time.





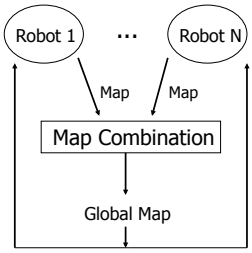
Urban Robot
" Color Camera
" 10 Sonar Transducers
" Encoders

Pioneer-AT
" Pan-Tilt-Zoom Camera
" Color-blob Tracking
" 7 Sonar Transducers
" Electronic Compass
" Gyroscope
" Encoders
" GPS Receiver
" Gripper

Pioneer-2DX
" SICK Laser Scanner
" 16 Sonar Transducers
" Electronic Compass
" Encoders

Multi-Robot Mapping

A landmark-based algorithm for map-matching was demonstrated in real-time to efficiently combine topological maps built by robots, which were initially unaware of each others position and orientation. This scheme represents a computationally cheap framework for a group of robots to localize themselves with respect to each other.



Ongoing and Future Research

- Experimental validation of the proposed cooperative mapping scheme
- Biologically-inspired map sharing and coordinated exploration strategies
- Simulation studies with larger number (> 10) of robots

Investigator Göksel Dedeoglu (dedeoglu@robotics.usc.edu)

Advisors Prof. George Bekey and Prof. Gaurav Sukhatme

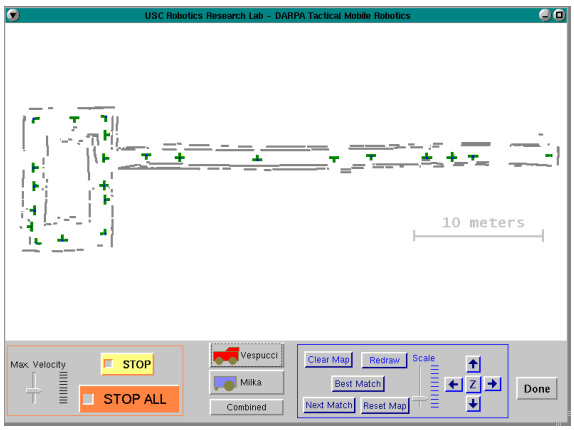
Publications (available from http://www-robotics.usc.edu/~dedeoglu)

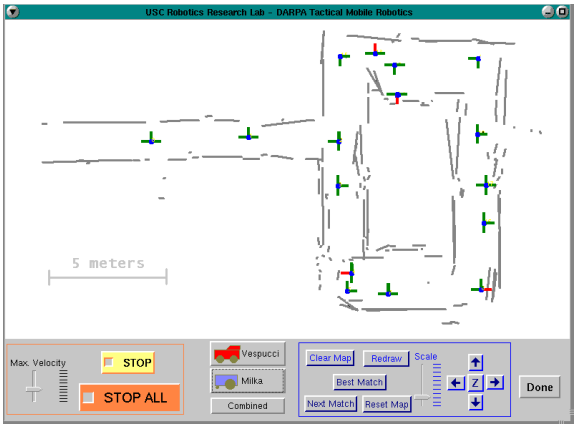
• Göksel Dedeoglu, Maja J. Mataric, Gaurav S. Sukhatme, "Incremental, on-line topological map building with a mobile robot", *Proceedings of Mobile Robots XIV* - SPIE, September 20-23, 1999, Boston, MA.

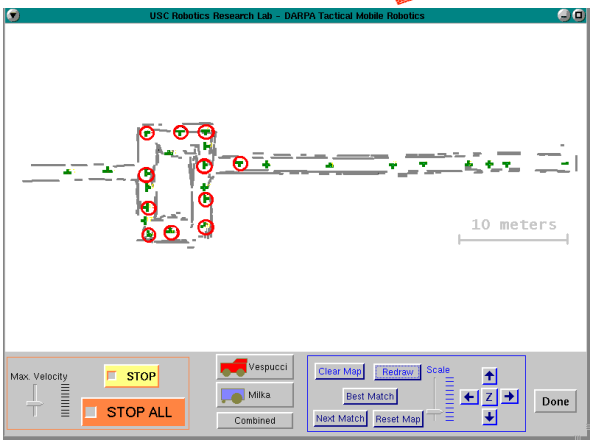
• Göksel Dedeoglu, Gaurav S. Sukhatme, "Landmark-based Matching Algorithm for Cooperative Mapping by Autonomous Robots", submitted to *IEEE International Conference on Robotics and Automation (ICRA) 2000.*

Supported by DARPA TMR Tactical Mobile Robotics

Landmark-based Matching for Cooperative Mapping







Investigator Göksel Dedeoglu (http://www-robotics.usc.edu/~dedeoglu)

Advisors Prof. George Bekey and Prof. Gaurav Sukhatme

Supported by DARPA TMR Tactical Mobile Robotics