Cooperative Localization for Groups of Mobile Agents

(TurtleBot with Qualcomm Snapdragon ARM CPU)
UCI Research Project Under the Mentorship of
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and
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The presentation is made by UCI student David Gogokhiya
What Is the Purpose of This Research?

Develop a robotic testbed for a robot localization Technique called **Cooperative Localization**
What Does Cooperative Localization Mean?

Finding your own position in the environment by sharing information between multiple objects.
How Does **Cooperative Localization** Work?

- Mobile agents take relative measurements between each other
- Share this information between each other
- Do computations to identify the position of every mobile agent
- Get the updated position
What We Used for Our Testbed?

We used multiple TurtleBots as the Mobile Agents.

We replaced the netbook controlling unit of a TurtleBot with a Qualcomm Snapdragon Microprocessor.

We used Robot Operating System (ROS) as our software Environment.
Mobile Agent – TurtleBot

- Low-cost robot especially made for education and research purposes
- Equipped with Kinect, a motion sensing device
- Create exciting applications using ROS and execute them on a TurtleBot
Qualcomm Snapdragon ARM CPU

- Powerful microprocessor
- Located on a single board
- Computer
- High performance
Robot Operating System (ROS)

Collection of frameworks to control Robots

No need to reinvent the wheel – Don’t Code what was already coded for you

Easy to learn

Open source
Combining all these components we are able to execute the **Cooperative Localization** Algorithm and prove its efficiency.
... But why do we need it?
Why don’t we use GPS?
GPS?

It is not always possible to receive Persistent GPS signal
GPS is not very accurate
GPS doesn’t work properly inside the Buildings
Furthermore, based on an experiment that we performed,
After 3.5 minutes of navigating the TurtleBot in a chaotic path we
Observed a 30 cm error in a robot’s location estimate
TurtleBot thinks that he is away from the initial position by 7 cm in the x-axis and by 34 cm in the y-axis but actually he is precisely at the location 0 cm, 0 cm.
Therefore, we have to come up with a different technique of how to localize the robot. **Cooperative Localization** is a perfect solution.
How We Developed Our Testbed?
How Do We Take the Relative Measurements?
We used **Kinect** as our motion sensing device to Detect other TurtleBots
... In order to distinguish TurtleBot from any other Obstacle we used Ar Tags
We have created an Ar Tag Cube
… And we put this Cube on each TurtleBot
In order to prove that our algorithm works we used an additional camera as a reference.
Camera is mounted to the Ceiling

It detects the TurtleBots
Based on the unique Ar Tag Cube located on every TurtleBot
In order to see the deviation in a path we
Also had to create a script to move the
TurtleBots in the predefined path
x <- actual path based on a ceiling camera

– <- pure propagation based on robot’s equations
Next Steps
Until the end of this week we plan to perform a test run with four Robots to see how efficiently our algorithm works.

After that we plan to make a test run when one of the TurtleBots Misses multiple messages with the updated position.
Future Work
Implement another more efficient algorithm

Make our system fully distributed – remove the workstation from the system to make it more reliable
And a Small Demo in the End