Towards Autonomous Navigation and Assembly: Infrared Detection
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**Project Setup**
- Robot has a computer mounted on top which is in charge of seeing the markers and sending back their information.
- It is in charge of exploring the environment and ultimately assembling the boxes that form the A&M logo.
- Markers have unique numbers and positions on the boxes and environment.
- They contain x & y coordinates in environment.
- Used for robot localization and positioning.
- Each contain programmed instructions for robot to follow.

**What is Motion Planning?**
- Motion Planning is the problem of finding a collision-free path from a start to goal configuration.
- Generates random samples to form a roadmap, then extracts the best valid path.

**The Goal of the Project**
Use Mobile robots to position objects by:
- Using visual aid to localize the robot and boxes.
- Planning a path for the robot to take.
- Finding appropriate tool to push objects.
- Recharging autonomously.

**Results**
- We found that the optimal tolerance value is 0.25 because it balances hardware and software error.
- We gathered x, y, and angle orientation of markers on boxes.
- We also measured the x, y, and angle orientation of markers on boxes.

**Experiments:**
- Centering: positioning the robot behind the center of mass of an object.
- Box positioning with and without a planar, pushing surface (plow)
- Markers were also placed on and around the boxes.
- We also measured the x, y, and angle orientation of markers on boxes.

**Centering Tests**
- Distance to box center (m) vs. Tolerance [m] vs. Time [s]
- Average Accuracy vs. Average Time

**Plow vs. No Plow:**
- In second operation, X Error decreased with plow
- %Error & Time were reduced with plow
- Unexpected inverse relationship between tolerance and error due to hardware downfalls

**Moving a Box a Set Distance off Two Walls (With Plow):**
- Average X Error vs. Average Y Error vs. Average Time

**Conclusion**
- We were able to localize, push a box to a specified location, and dock with the robot. Performance was improved by adding a plow and refining the tolerance value.
- Future work includes extending this method to more complex scenarios with multiple objects and robots.

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**Method**
- Able to successfully acquire data from the markers e.g., position of marker, distance and angle to the robot.
- Robot can successfully push a box forward a given distance with a margin of error under 5%.
- Robot can accurately compute the distance between two markers and wall.
- Robot uses trigonometric functions to center itself in front of the box, facing towards it.

**Infrared (IR) Sensor Setup**
- The Home Base emits infrared signals in fields, including left (blue), middle (purple), right (orange), and a force field (yellow).
- The robot would then use its own infrared sensor to locate itself within the fields of the Home Base.

**Problem:** The robot needs to recharge at the Home Base after assembly or when needing charge.

**Final position?
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- Position robot to a neighboring side of the box.