Enabling Feedback Force Control for Cooperative Towing Robots

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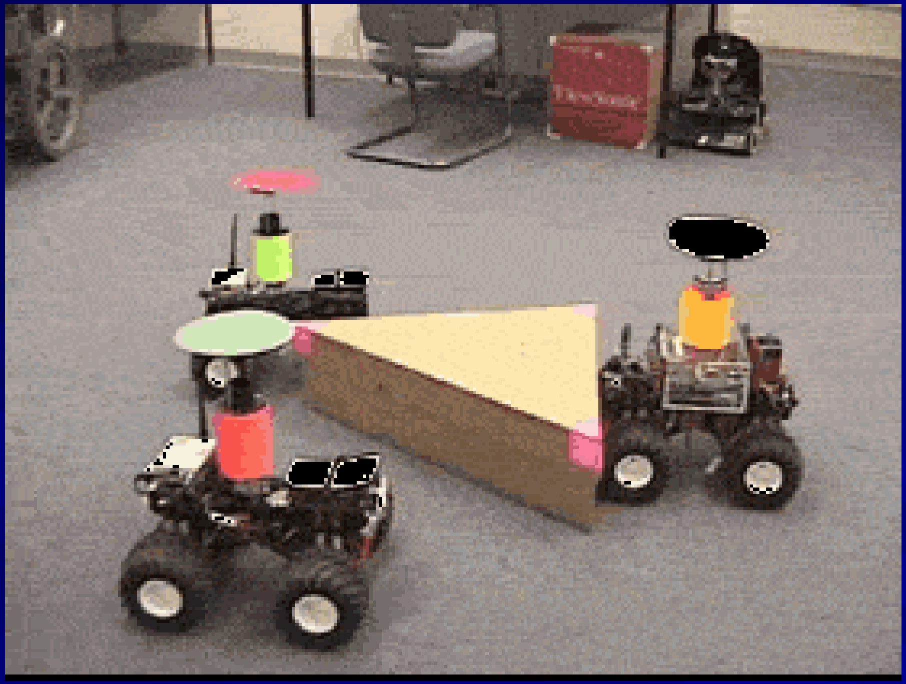
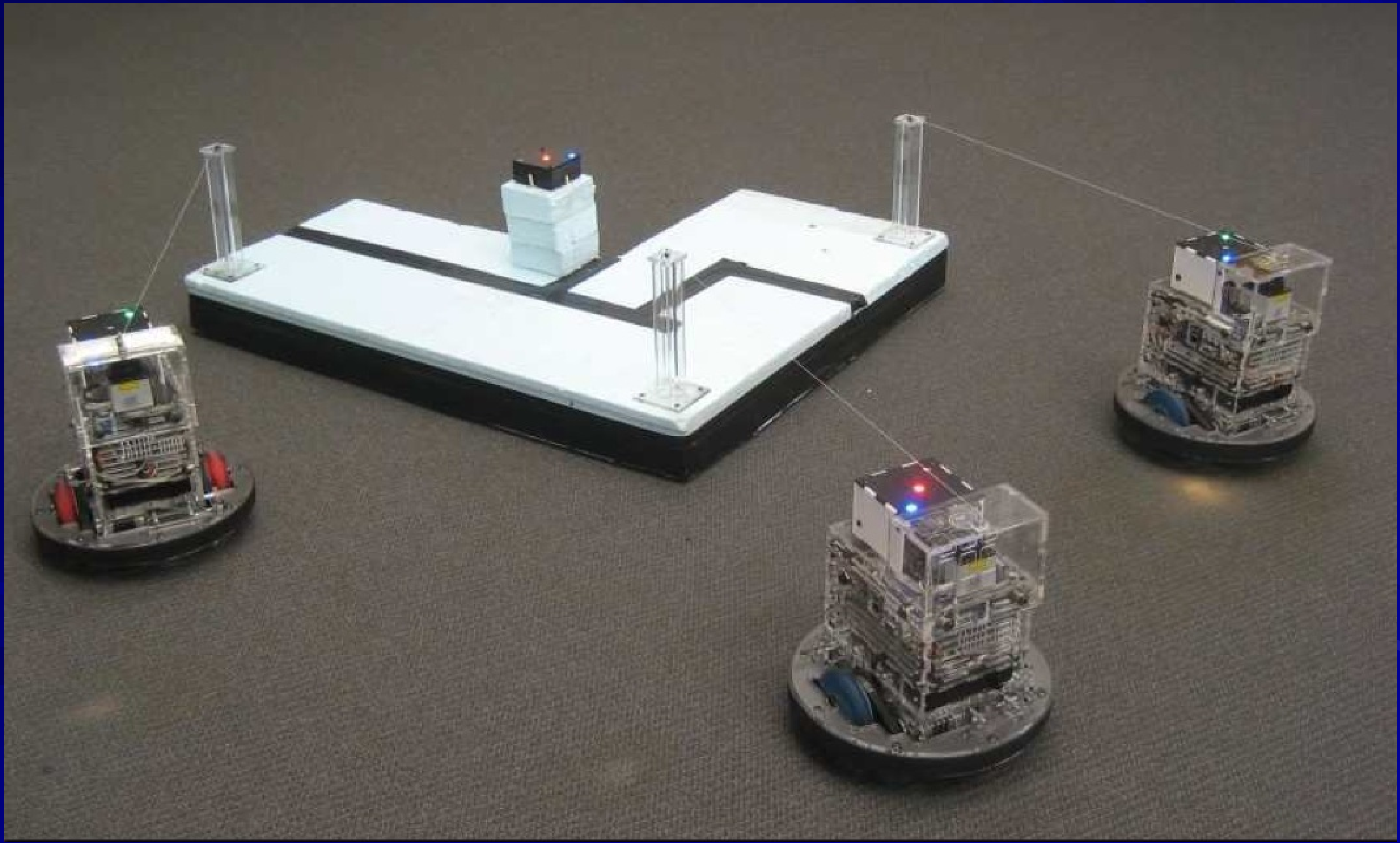
Overview



__Cooperative Robotics:__

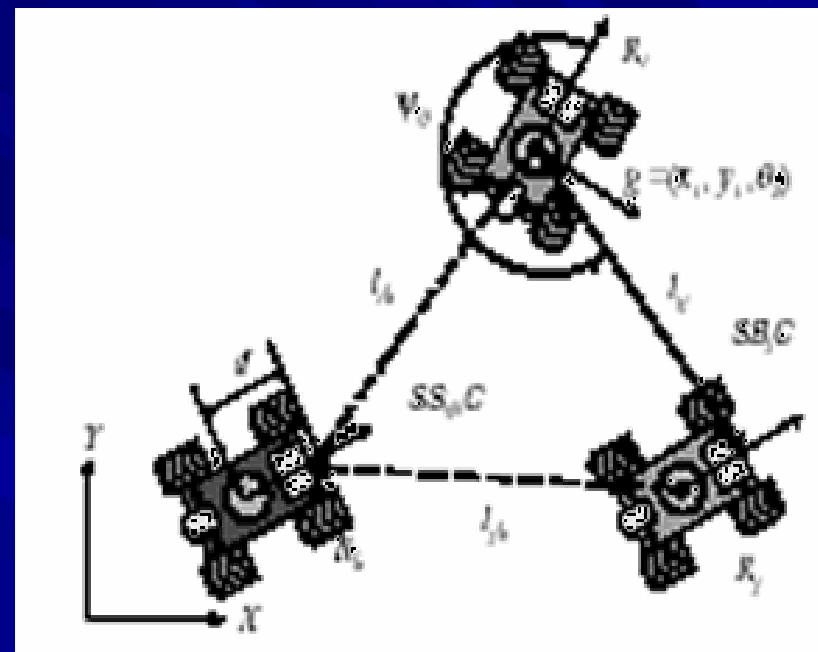
Multiple robots working in coordination through sensory perception or explicit communication, to accomplish a set task

Cooperative Towing Robots

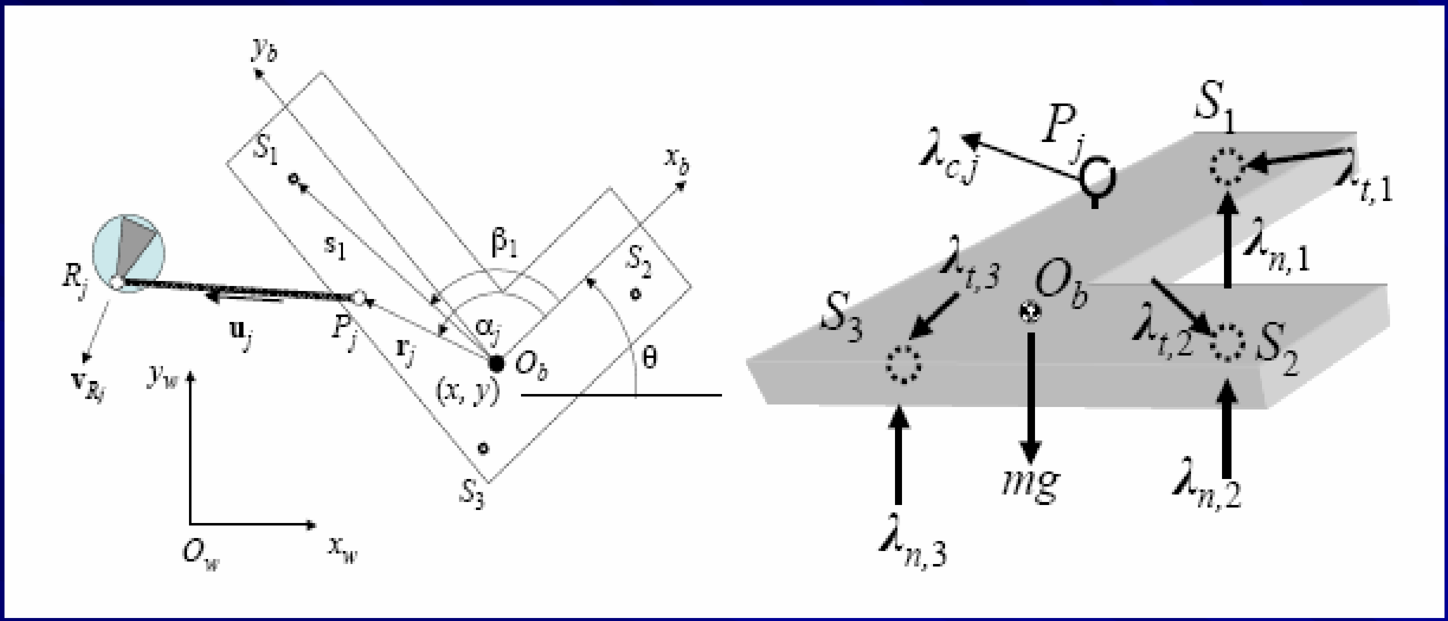


Pros of Cooperative Towing

- Multiple robots doing the same task is faster than just one robot
- Decentralized system, shares load/work equally
- Easily adaptable to changes in environment
- Increased accuracy & autonomy in simple tasks

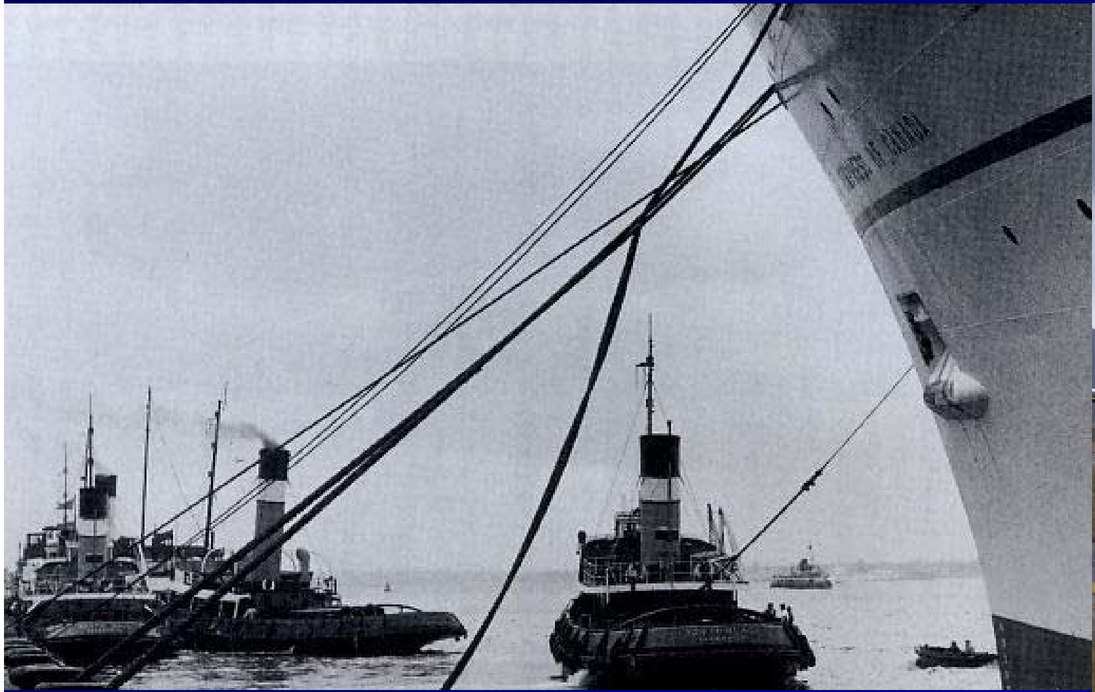


Cons of Cooperative Towing



- Our model assumes quasi-static manipulation (i.e. manipulation at low speeds)
- Errors in location and position due to dry frictions on the payload and lack of feedback

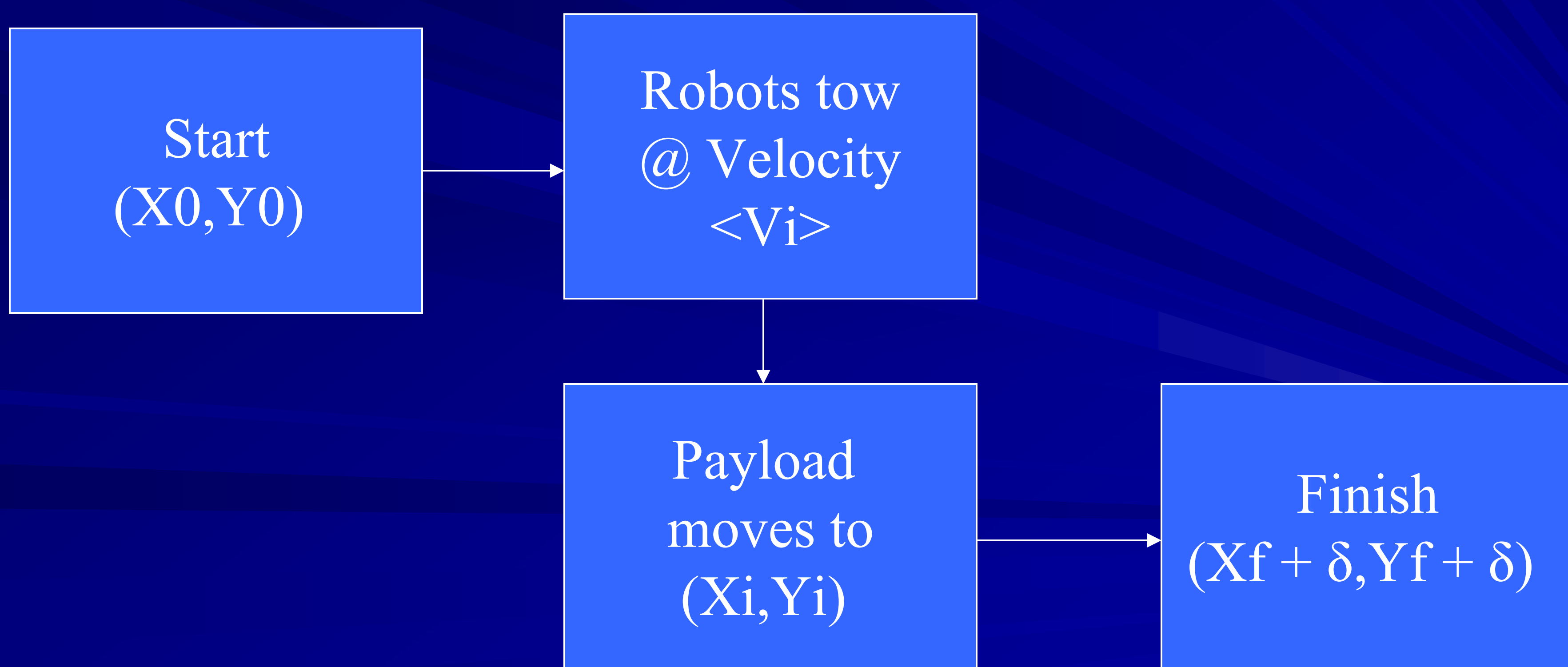
Motivation



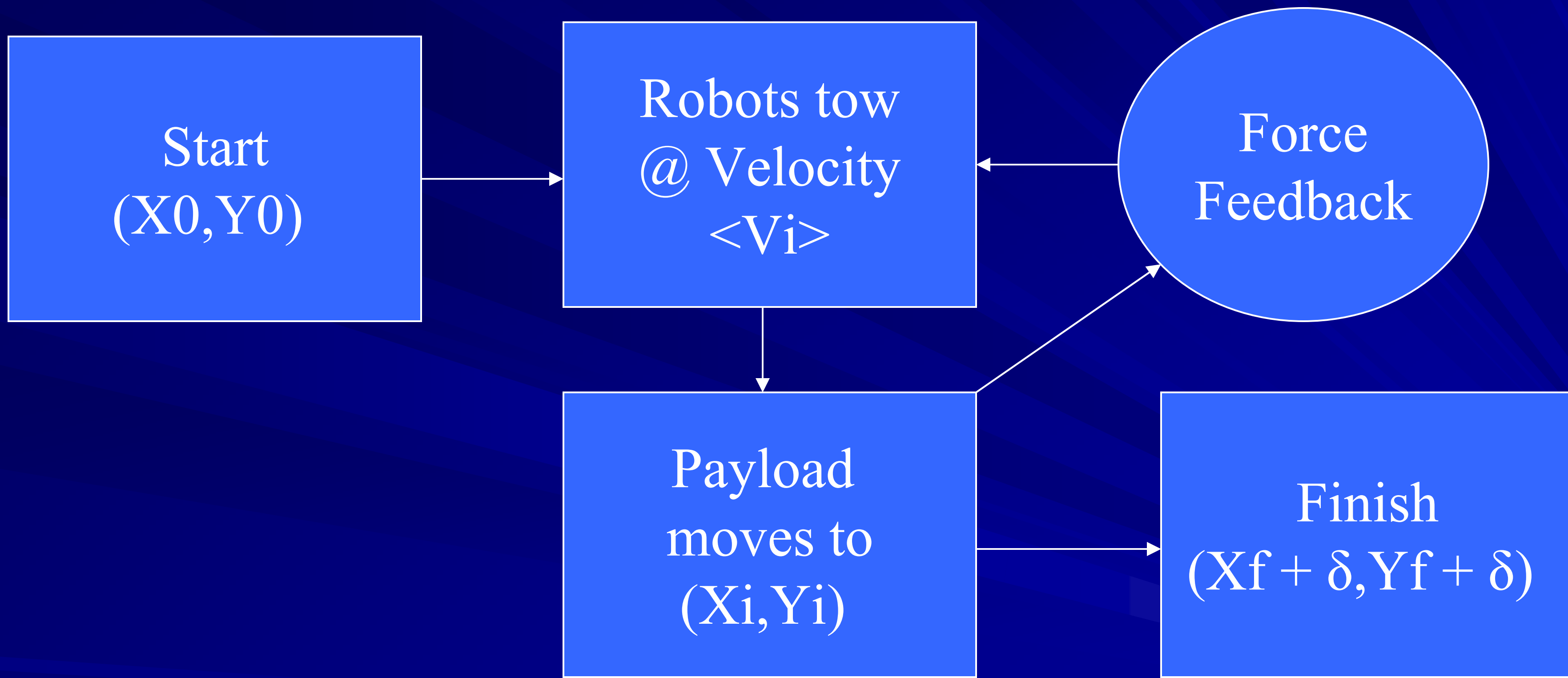
To implement a fully autonomous and accurate cooperative towing system in the real world.

Problem

To implement a feedback system that reduces positional error (δ) and increases the accuracy of towing objects to a specific destination (Xf, Yf).



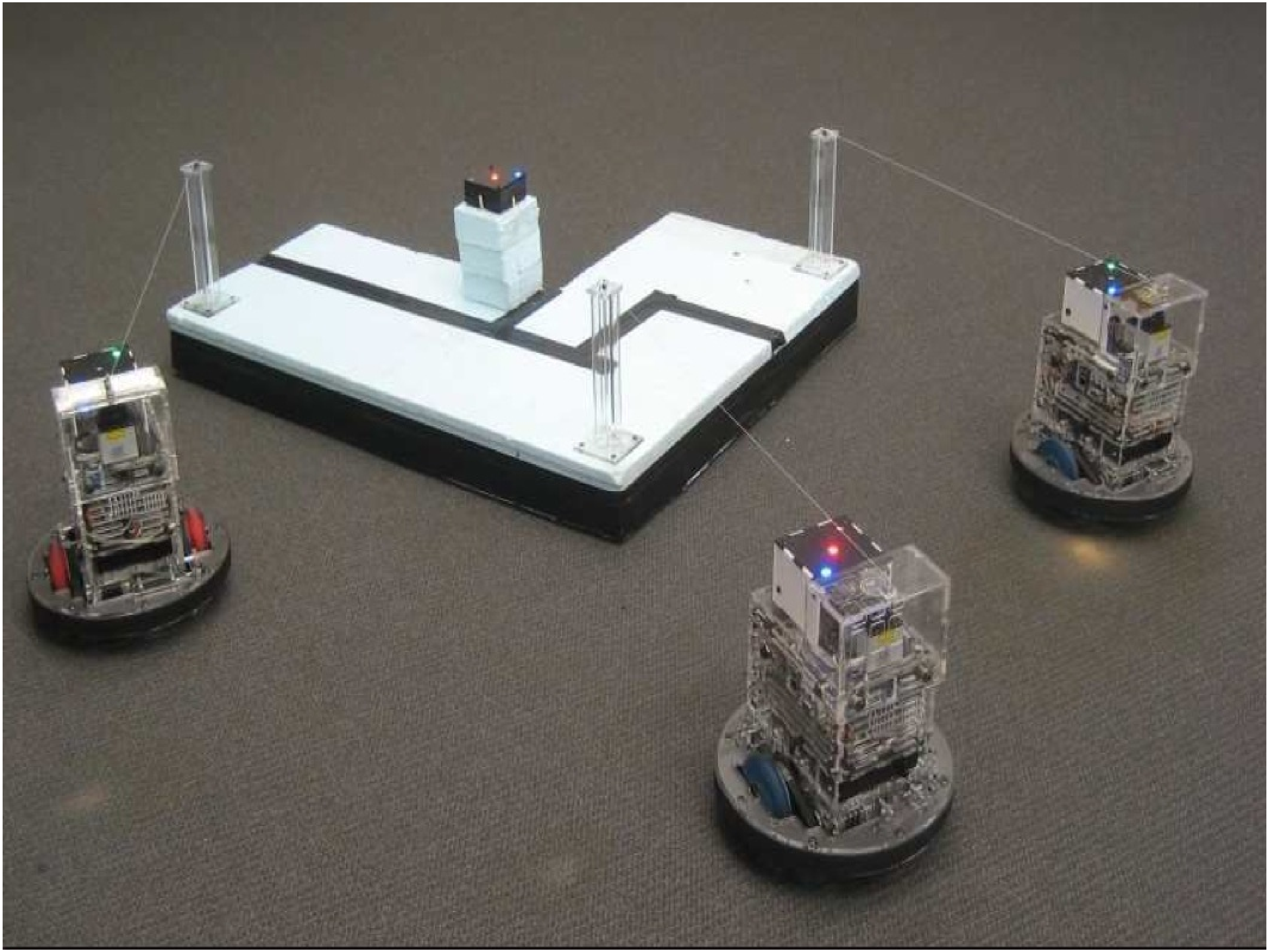
What is Feedback?



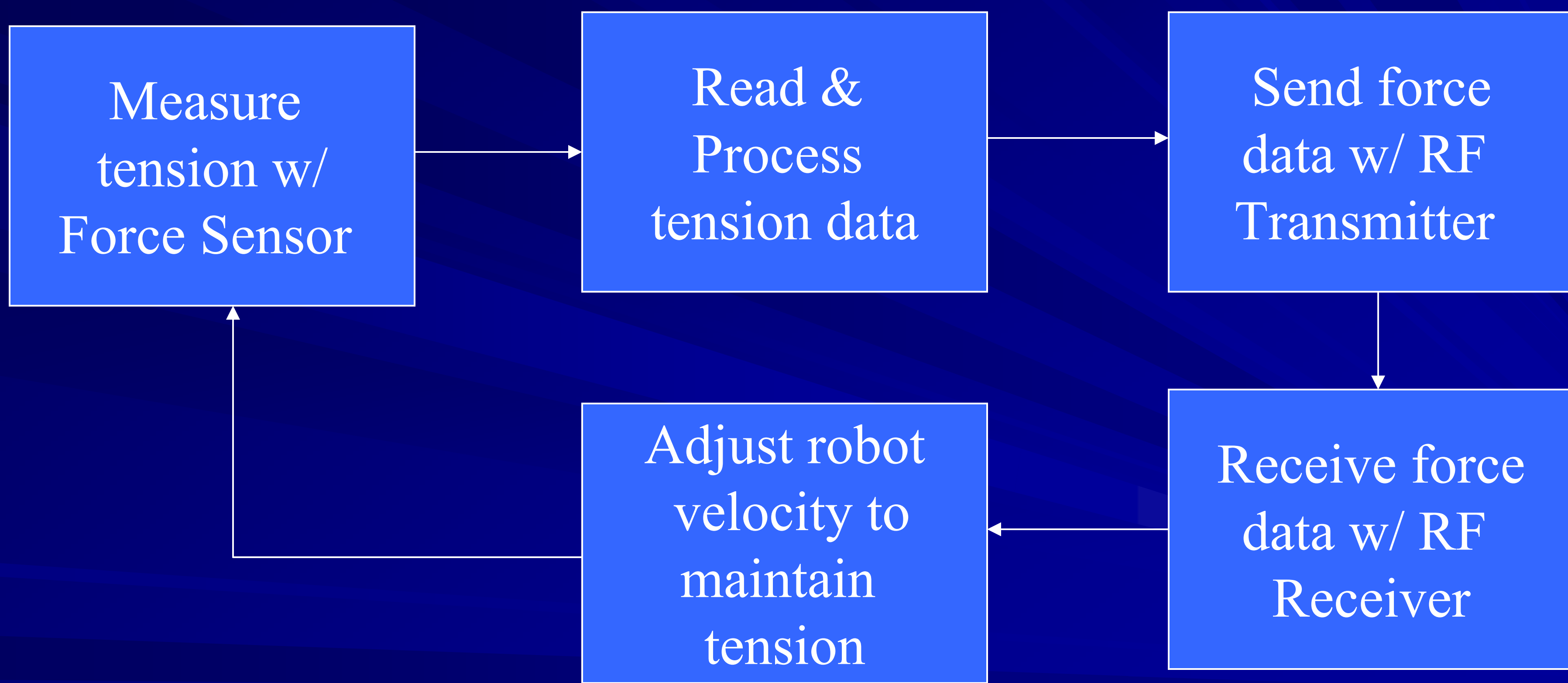
Feedback is the process of feeding part of the output back into the input to control the behavior of the system.

Method and Results

Create a force feedback system to maintain constant cable tension and reduce error (δ) in the final position/destination.



Outline of Feedback System



Measure tension w/ Force Sensor

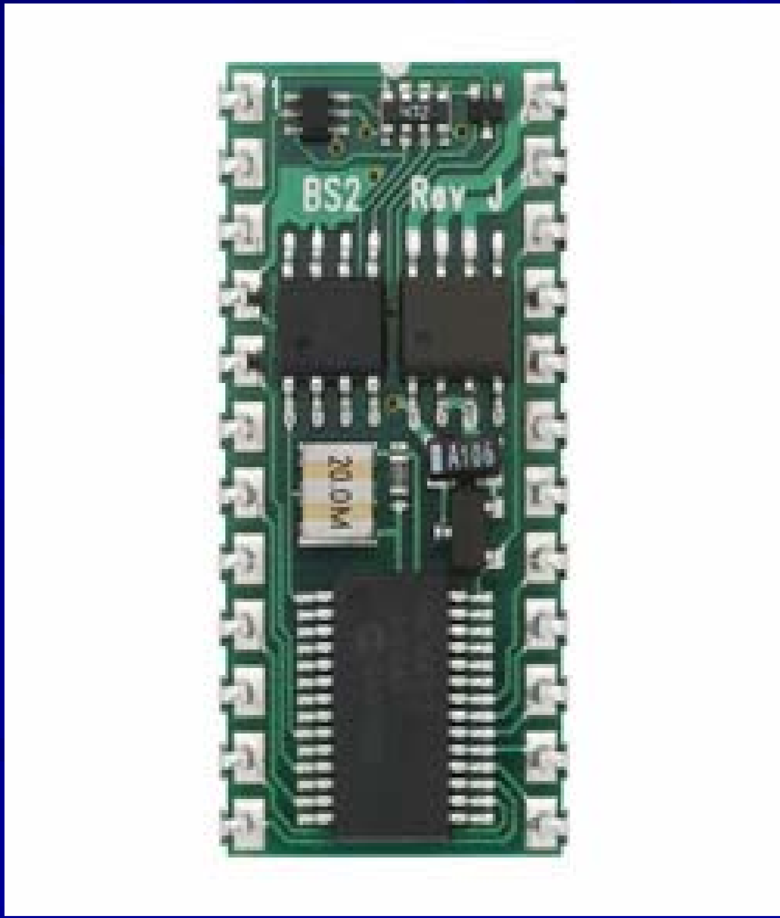
Force Sensor: iLoad Mini Load Sensor

- Outputs frequency in proportion to the applied load
- Range of 180-250 kHz (depending on sensor)
- Compensated for temperature & calibrated for tensile forces

Read & Process tension data

Force Data Processing: BASIC Stamp 2 Module

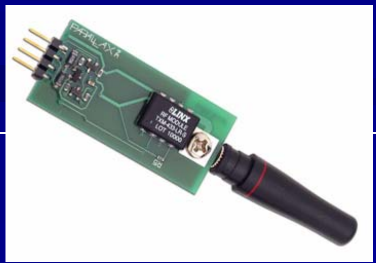
- Easily programmed with PBASIC 2.5.
- Compatible w/ sensors and well-documented
- Small RAM size: 32 bytes (stores only 26 one-byte variables)
- Single-threaded microprocessor



Wireless Communication: RF Transmitter & Receiver

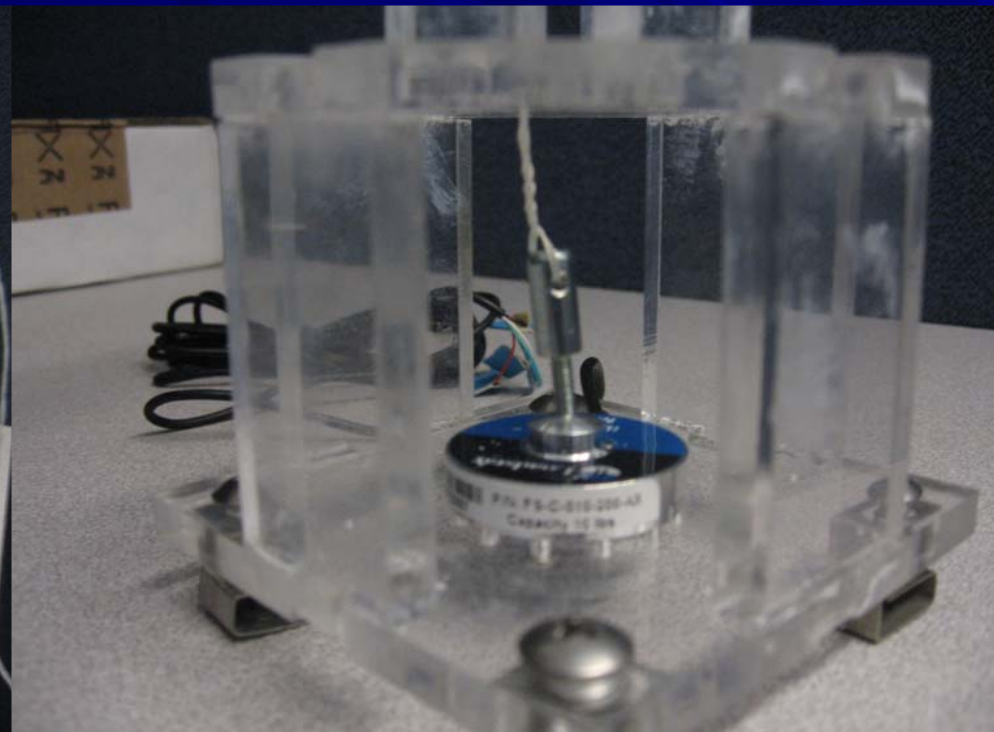
- Operate at 433.92 MHz
- Transmission range of a couple hundred feet
- Compatible with BASIC Stamp 2
- High baud rates (up to 19.2 k baud)

Send force data w/ RF Transmitter



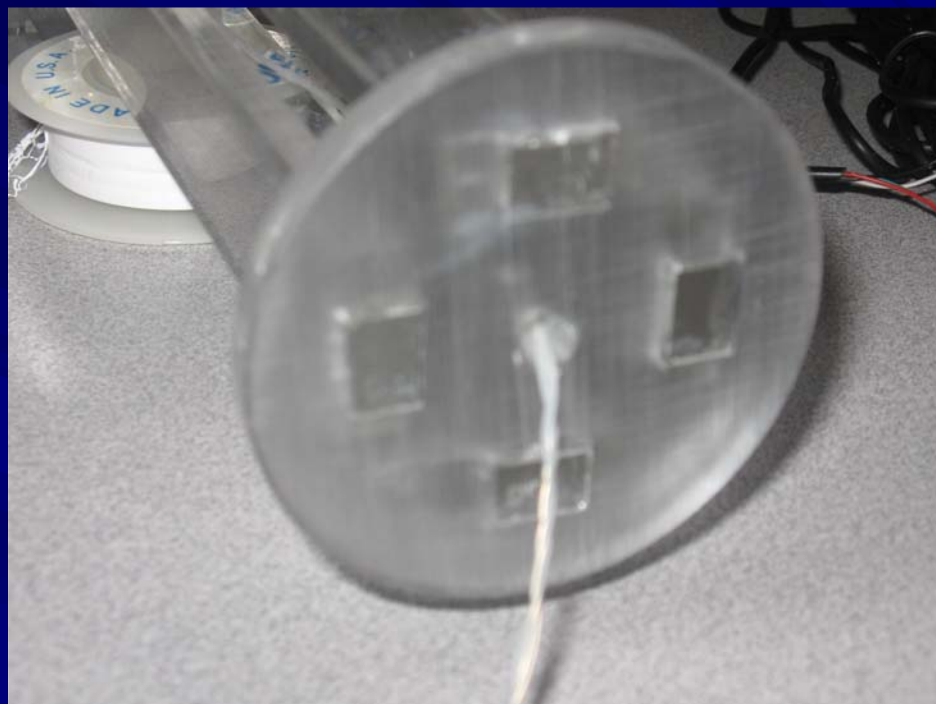
Receive force data w/ RF Receiver

Feedback System: Tower



Towers have cables attached to the iLoad Mini Load Sensors, using screws with holes. They are also built to align and read the cable tension.

Frictional Errors in the Tower



There was significant frictional error between the cable and the top of the Tower. Attempts to reduce the error did not work as well as hoped.

Feedback System: BASIC Stamp 2

Reads, processes, sends, and receives tension data at approximately 3x a second.

Future Work

- Integration of all three towers into the cooperative towing system
- Implementation of an interface between BASIC Stamp 2 and the robot's positioning system
- Reduce frictional errors
- Test w/ different revisions of the BASIC Stamp 2 or multi-threaded microprocessors
- Test w/ different load cells

Impact

Our research furthers the reality of a fully autonomous cooperative system that is both accurate and efficient.

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Camera Man	CLARNECE AGBI
Key Grip	CLARENCE AGBI