MP4: Improve Your Navigation Using Feedback Control

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By: Rohan Tabish

Recap - MP2 - Ancient Mine Exploration

Farmer planting tree

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Uncovers a maze

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The maze is labeled as archeological site.
So there are requirements that robot must follow.

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- Requirement # 4: Finish as quickly as possible

Recap - Map the Tasks to Criticality Levels We Defined

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    - Lowest Period, fastest response
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  - Motion Control, Tracking and Navigation etc
  - Follow the wall, tracking trajectory

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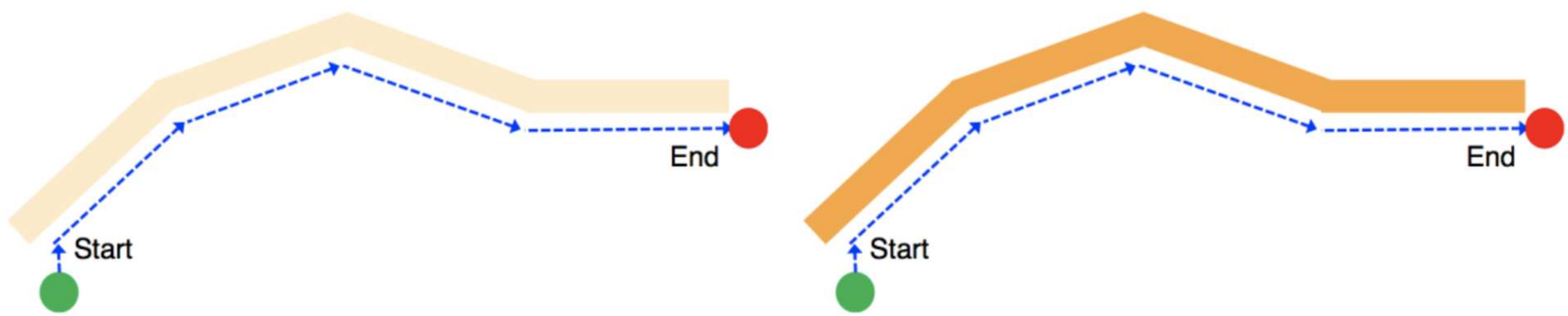
- **Performance-critical: Quality of the mission**
  - Lowest Priority
  - How many times hit the wall
  - Time to finish

MP4 - Follow the Wall without Hitting



(a) (b)

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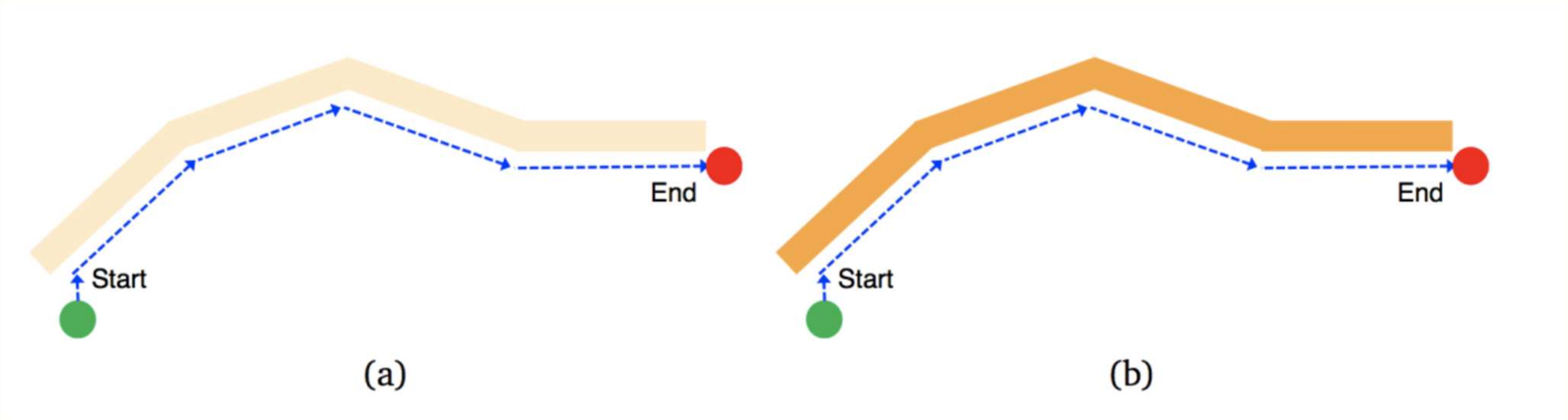

(a) (b)

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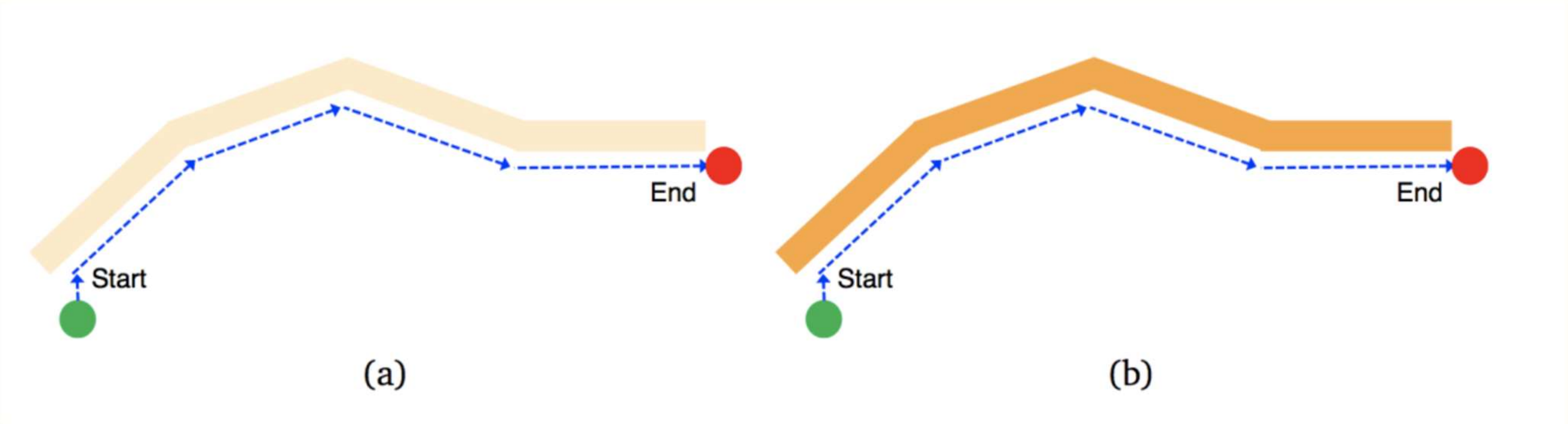

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- Minimize bumps to the wall - every bump takes away 50 % of score of “Number of bumps”

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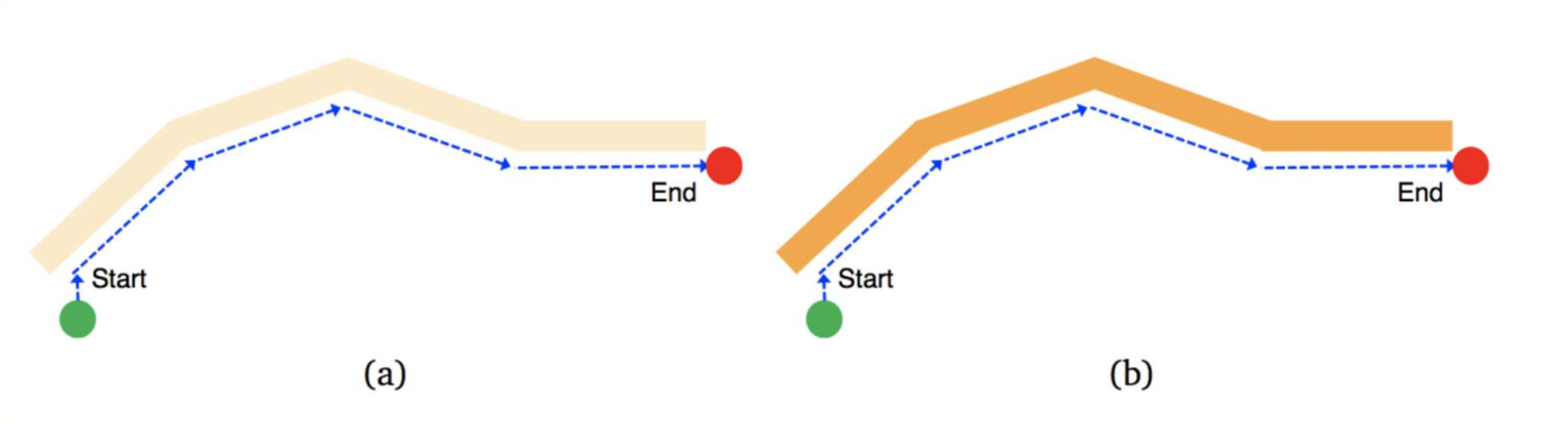

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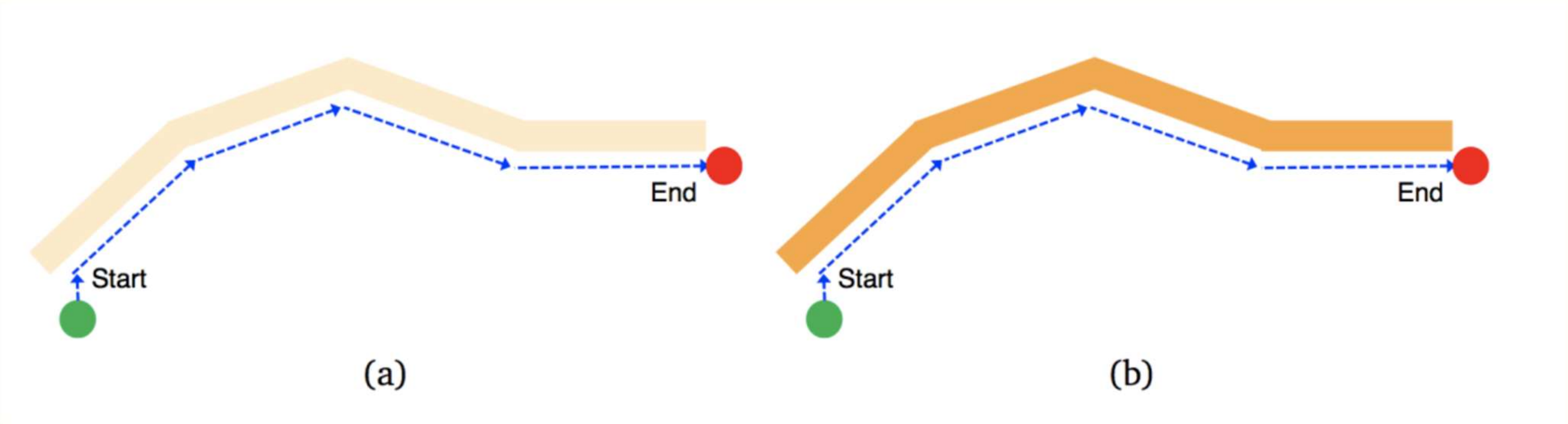

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- Minimize bumps to the wall - every bump takes away 50 % of score of “Number of bumps”
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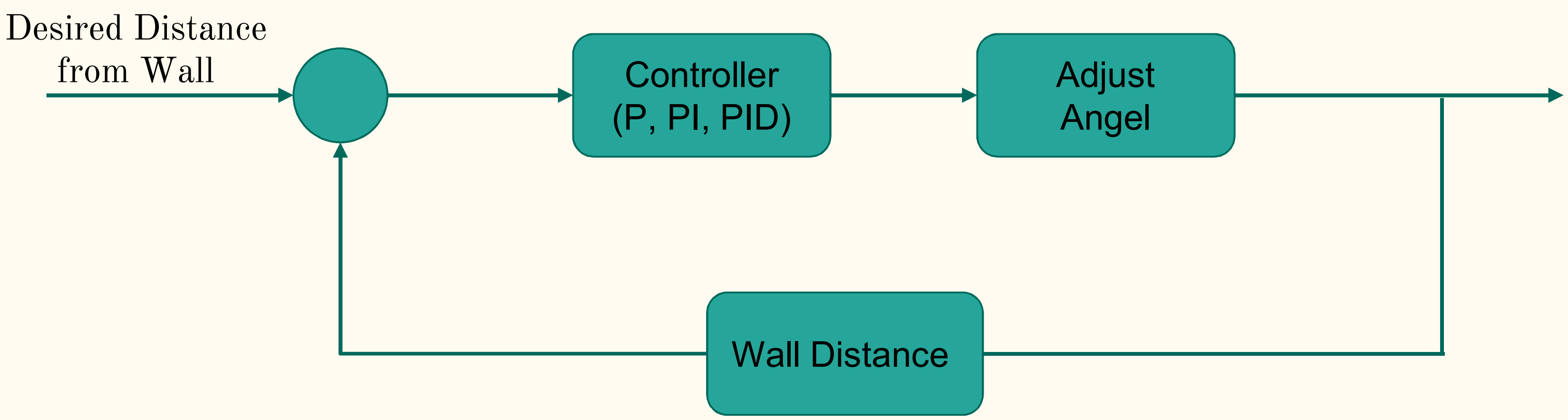
- Cliff Signal, Overcurrent, and Wheel drop sensors, and take appropriate actions when they trigger

MP4 - Controller Design

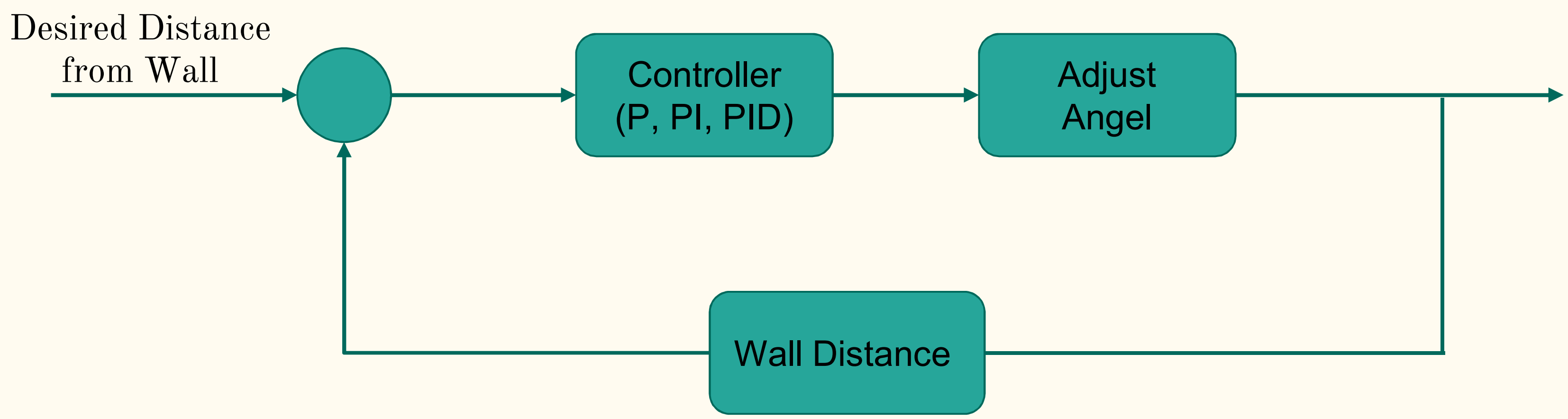


Output = K * Input

→ Input is measured wall sensor value

→ Output: Turn angle (adjustment)

MP4 - Controller Design



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The controller is invoked every period T.

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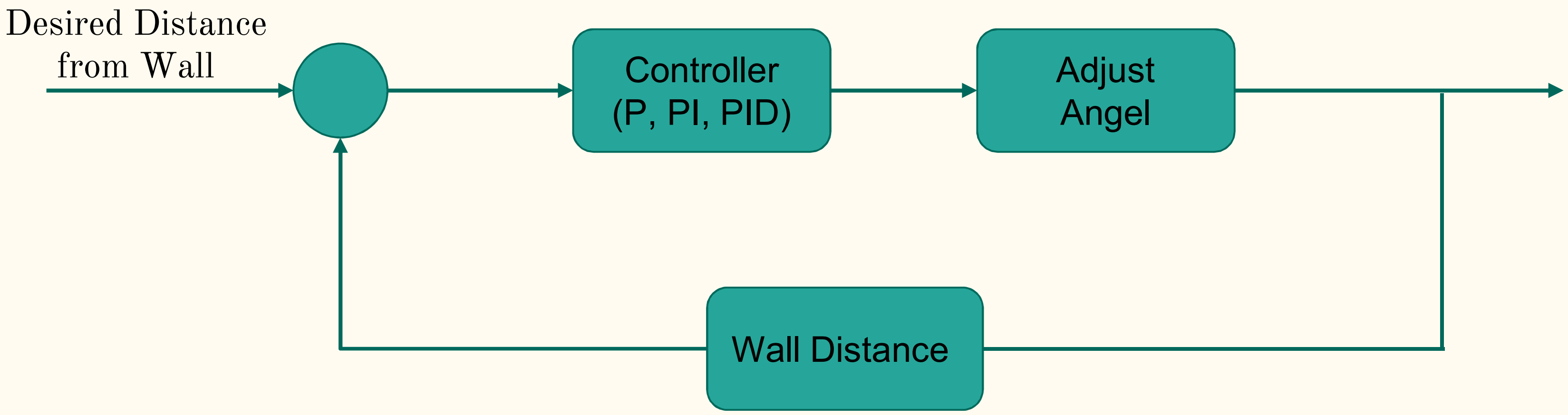

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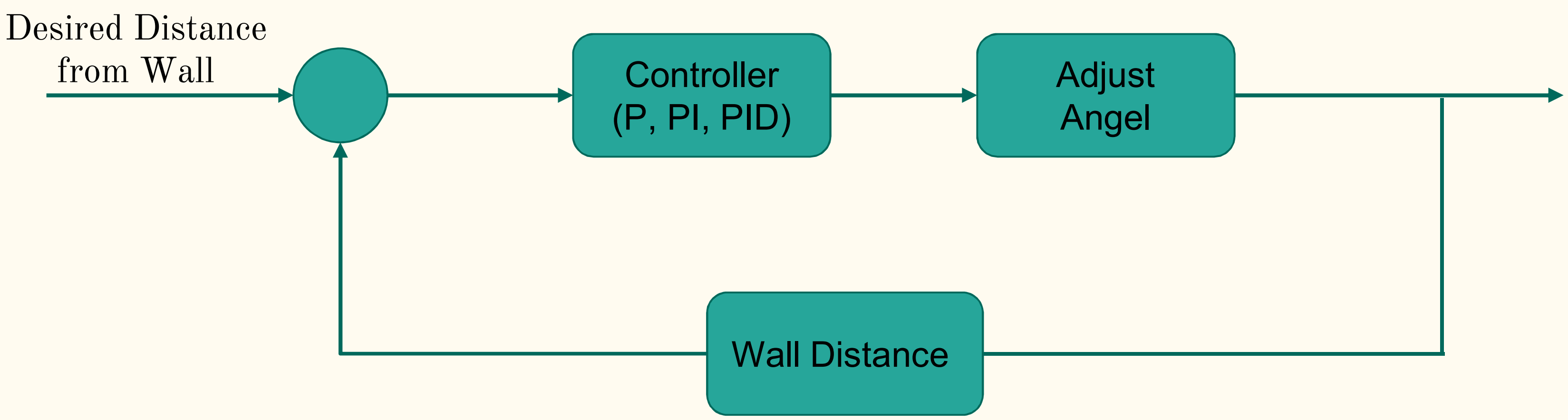
The controller is invoked every period T.

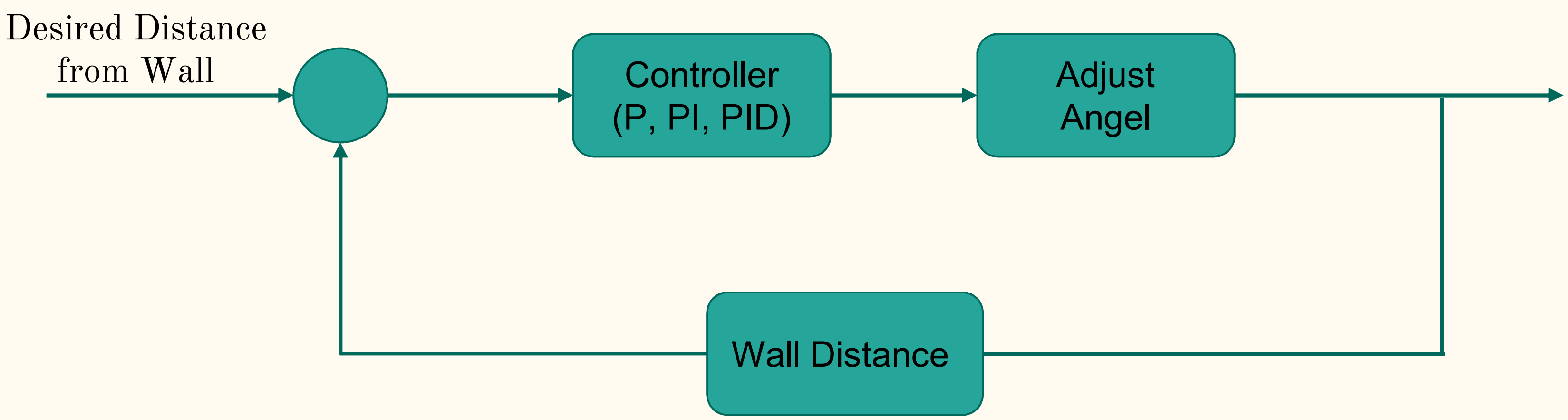
Pick the correct T depending on the speed of the robot.

MP4 - How to Determine K



Control theory offers a way to determine *K*, given a selected value of controller period *T.*

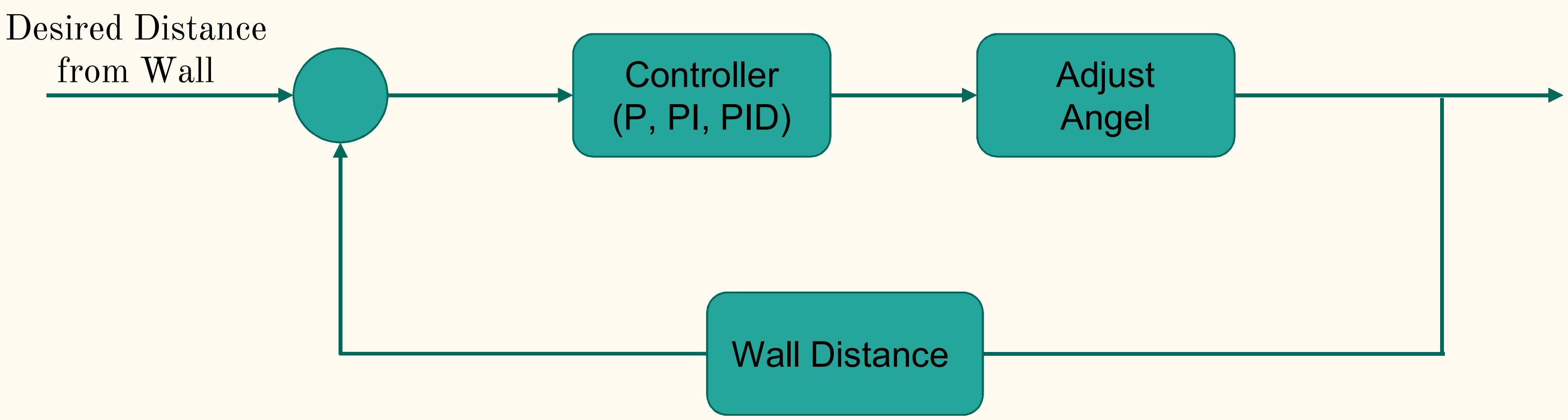
MP4 - How to Determine K - Model the controlled process:



- The model should describe an approximate relation between the angle adjustment done by the controller and resulting distance to the wall

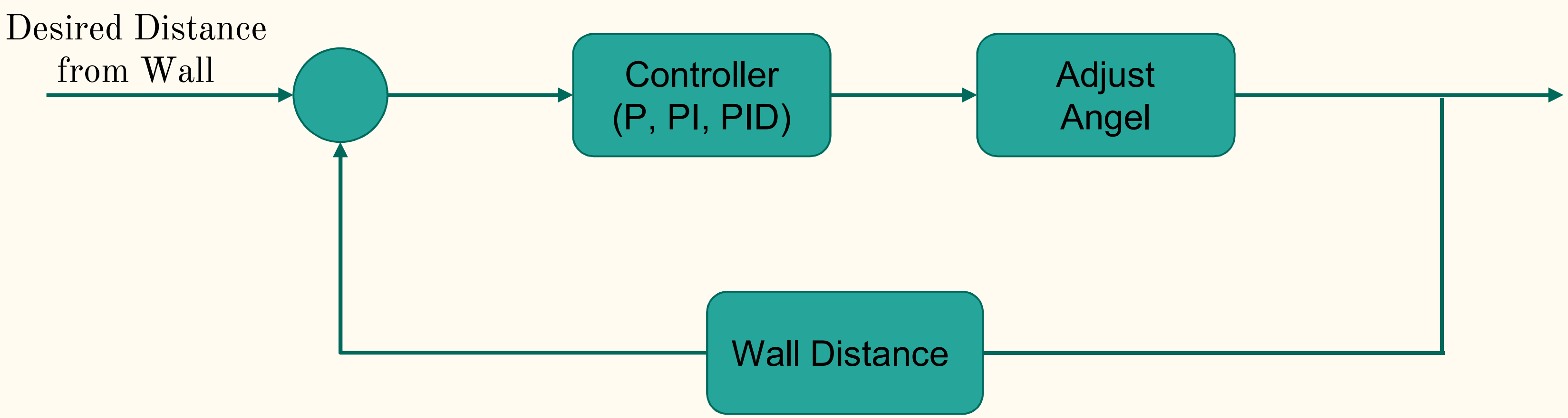
- How distance will change when the robot turns

MP4 - How to Determine K - Model the Wall Sensor



- Sensor model should describe the approximate relation between physical distance to the wall and sensor output.
- Empirically by moving robot near and away from the wall.

MP4 - How to Determine K - Developing Controller



- Develop the controller - Which controller you implemented P, PI, PID
- Remember the K value for each controller will be different. K_p, K_i and K_d

Grading - Read More Details in the MP Description

	Requirement	Points
1	Design Report	
1a	Modeling the Robot	2
1b	Profiling the Sensor	2
1c	Controller Design (from Phase and Gain Equations)	2
	Report Total	6
2	Implemetation	
2a	Time in Maze	2
2b	Number of Bumps	2
	Implemetation Total	4
	Total	10

Thank You