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Carnegie Mellon

Learning by Building Robots: (Directed Constructionism)

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Motivation

- Inspire
- Endow rigor
- Design
- Work in teams

Robotics Minor @ CMU

- Required Courses:
 - Introduction to Robotics (16-311)
 - Controls
 - Manipulation / Kinematics
- 2 Electives
 - Mobile Robot Programming
 - Mechatronics
 - Vision
 - Independent Study

Introduction to Robotics (16-311)

- Rube Goldberg Machines
- Braitenberg Vehicles
- Control
- Motion Planning
- Design
 - Mars Rover
 - Urban Search and Rescue
- Forward Kinematics
- Inverse Kinematics
- Non-holonomic constraints



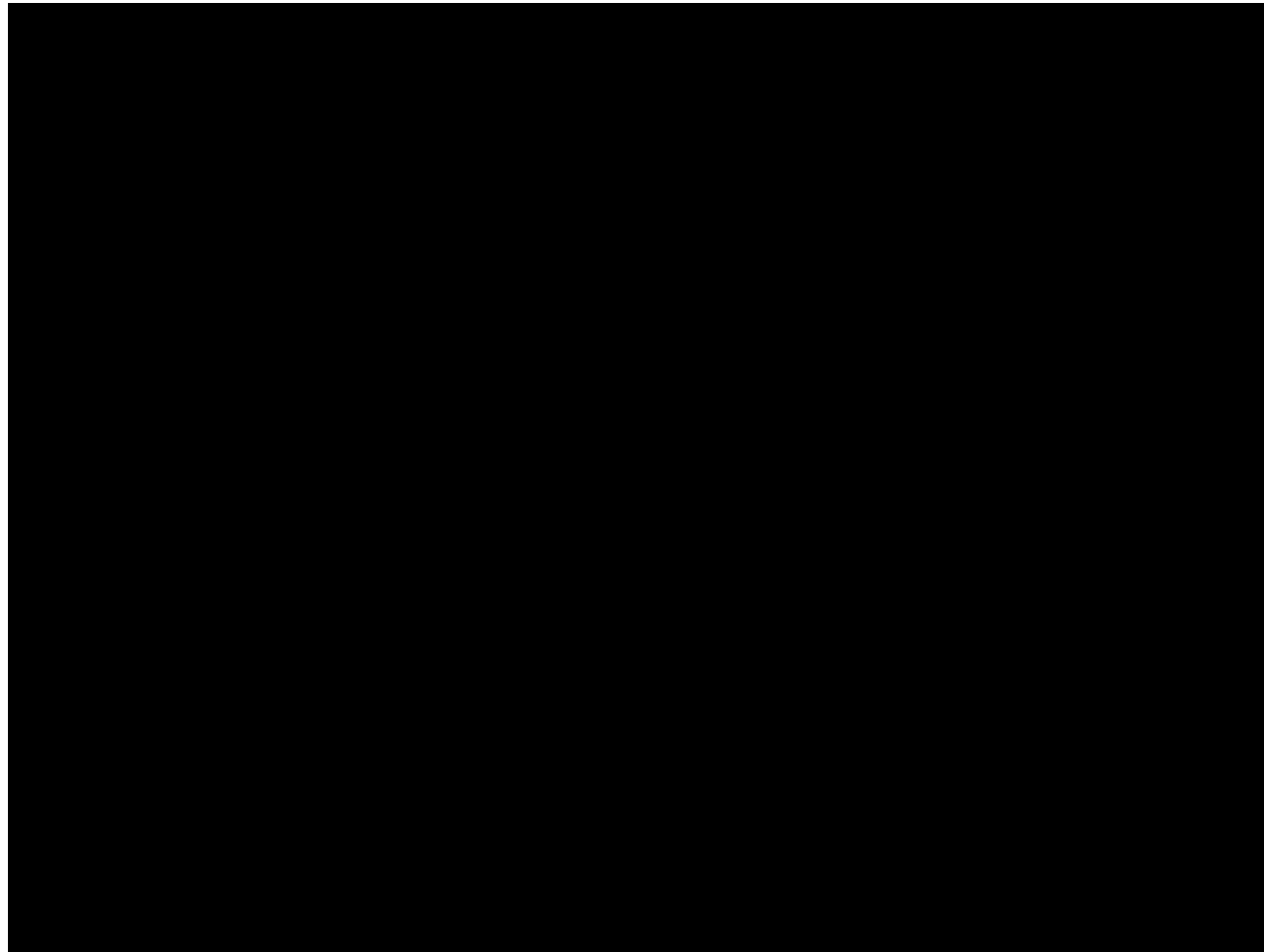
Path planning and friction error

Gateway robotics course for undergraduates

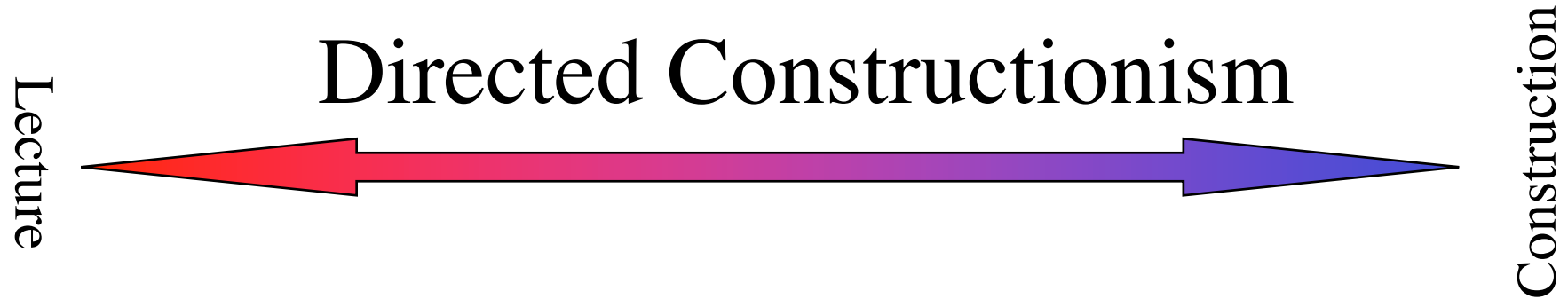
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Creative Expression: USAR Lab



Instructional Model	Constructionism
<ul style="list-style-type: none">• Lecture based.• Flow of knowledge is unidirectional.• Caters well to curricular structure.• Works well with large class size.• Leaves us wondering if students really connect with the knowledge.	<ul style="list-style-type: none">• Students develop knowledge by engaging in the construction of physical artifacts.• Individual, self-paced.• When building things, a lot can go wrong - a strength.• Experience is enhanced when projects are personally meaningful.• Instructor becomes a mentor.



- Artifact construction component that parallels curriculum.
- Design/construction tasks are open ended, allowing opportunity for creativity.
- Assignments attempt to be personally meaningful in that they validate theory on a real artifact.

Lab format and presentation

- Introduction
- Reading
- Pedagogical focus
- Challenge statement
- Evaluation criteria
- Construction tips
- Things to think about

Lab Culture

- Many late nights in the lab.
- Students teaching other students.

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Example Lab Format

go to <http://generalrobotics.org>

Future Investigations

- Upgrading the NXT Systems
- What new tools and methods are required to allow robot building to enhance other subjects?
 - Math, physics, biological sciences.
- Other levels of education
 - Secondary, elementary

Conclusion

- Inspire
 - Robots are cool
 - Not teach CS for CS sake
- Endow rigor
 - Learn something real
 - Teach the realities and depth of science
- Design
 - Use tinkering to explore
 - Connect high and low level issues
- Work in teams