Projects in Electrical & Computer Engineering 2007-2008

Autonomous Ground Vehicle

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Project Advisor(s): CAPT Hartnett, Prof Swaszek (URI), LT Taylor (URI)

Sponsor: C2CEN and NAVCEN

Introduction

- Design/Construction of Autonomous Ground Vehicle
- Purpose: For participation in Intelligent Ground Vehicle Competition
- Vehicle Autonomy and the Coast Guard
- Positively Represent CGA Engineering

Main Points

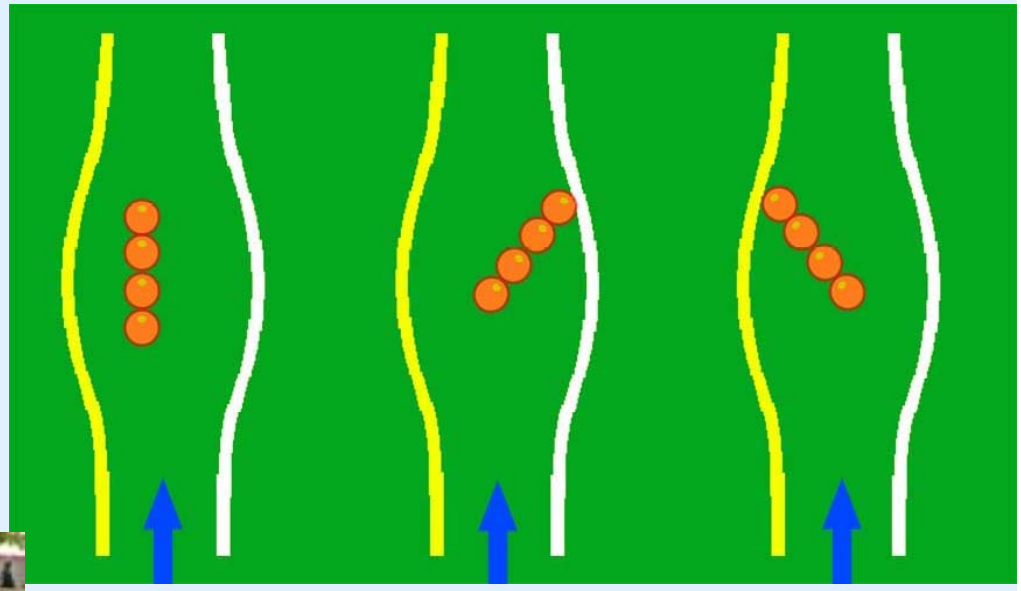
- What is the Intelligent Ground Vehicle Competition?
- Design Problem and Our Solution
- Project Results

What is the IGVC?

- 3 challenges of IGVC
  - Design challenge
  - Autonomous challenge
  - Navigation challenge

What is the IGVC?

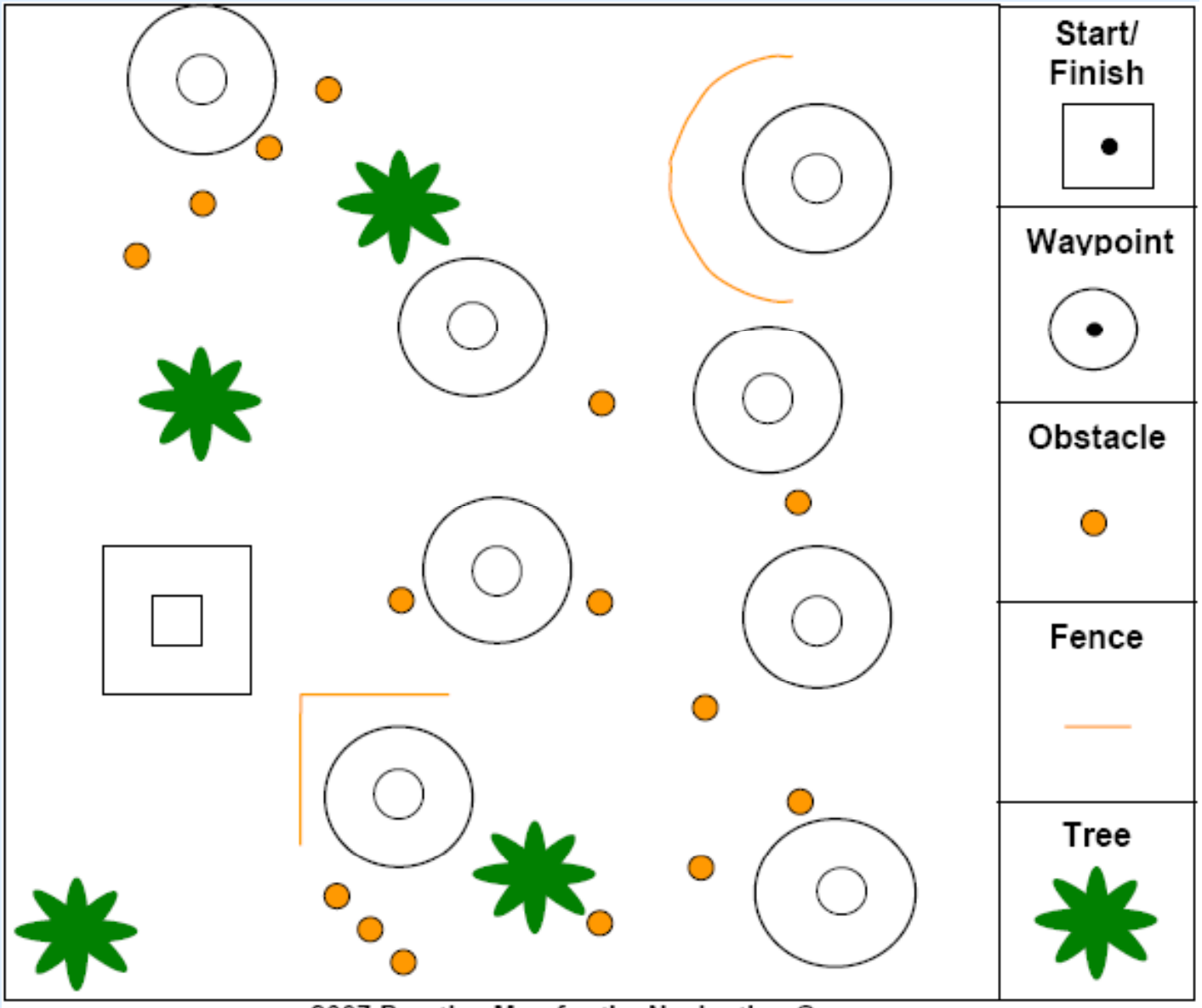
- Autonomous Challenge



- Obstacles
- Lanes

What is the IGVC?

- Navigation Challenge



2007 Practice Map for the Navigation Course

2006-2007 AGV Team

- Vehicle
- LT Everette's Contributions
- Potential Problems

Results

- Phase 1 (Fall):
  - Vehicle Frame
    - Adaptability
  - Drive System
    - Maneuverability
  - Motion Control
    - Transferability

Phase I Results

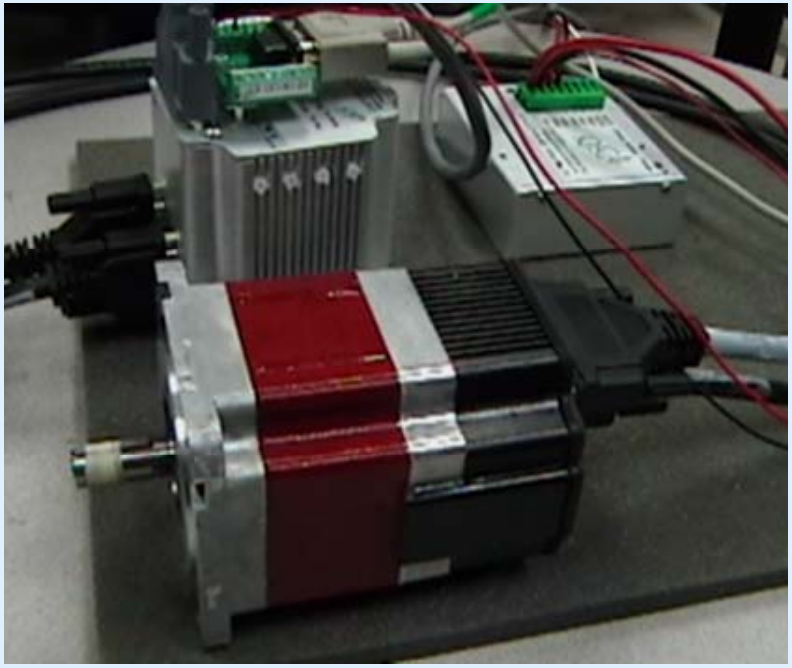
- Frame Size
  - Adaptability

Phase I Results

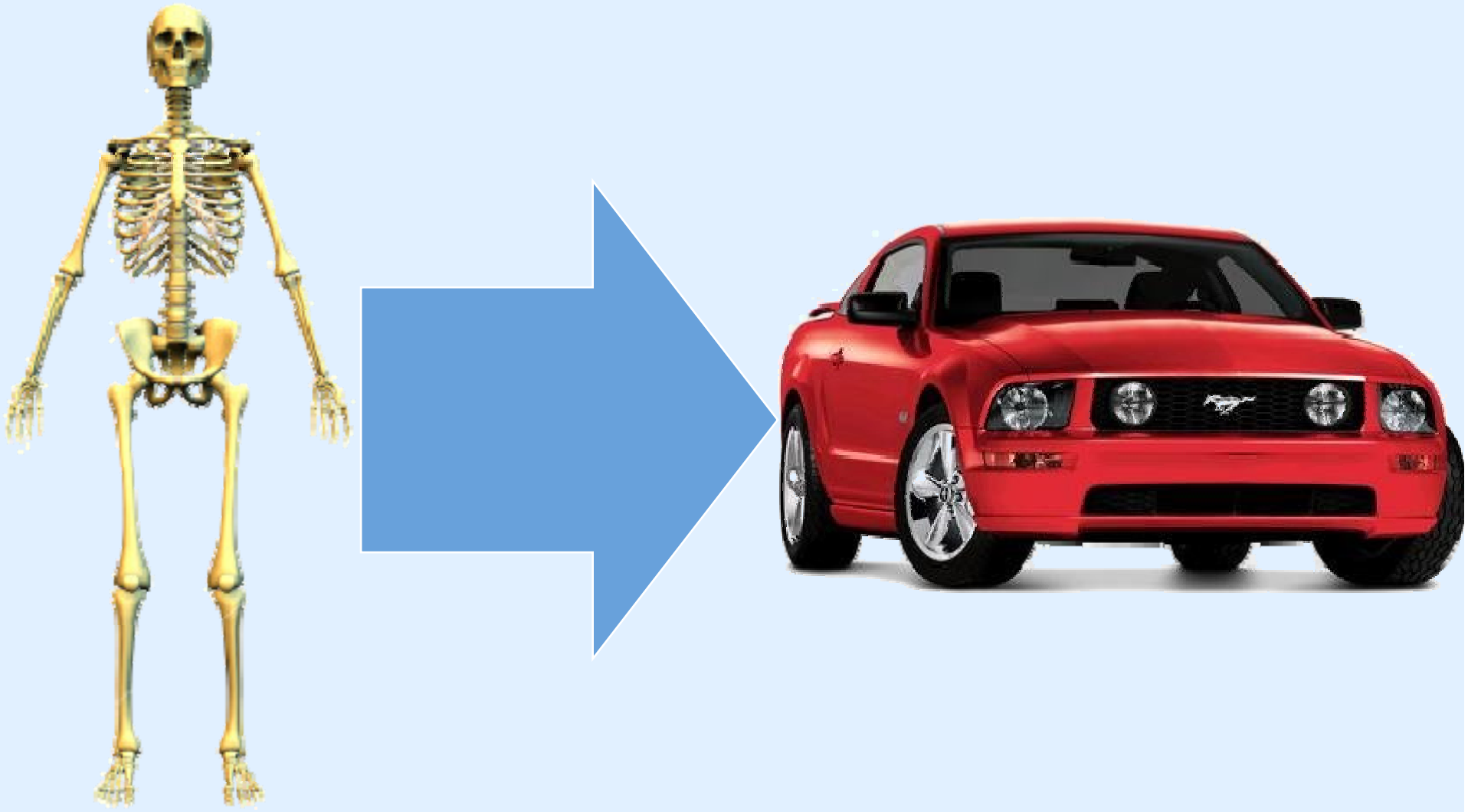
- Drive System
  - Maneuverability

Phase I Results

- Motor Control
  - Transferability



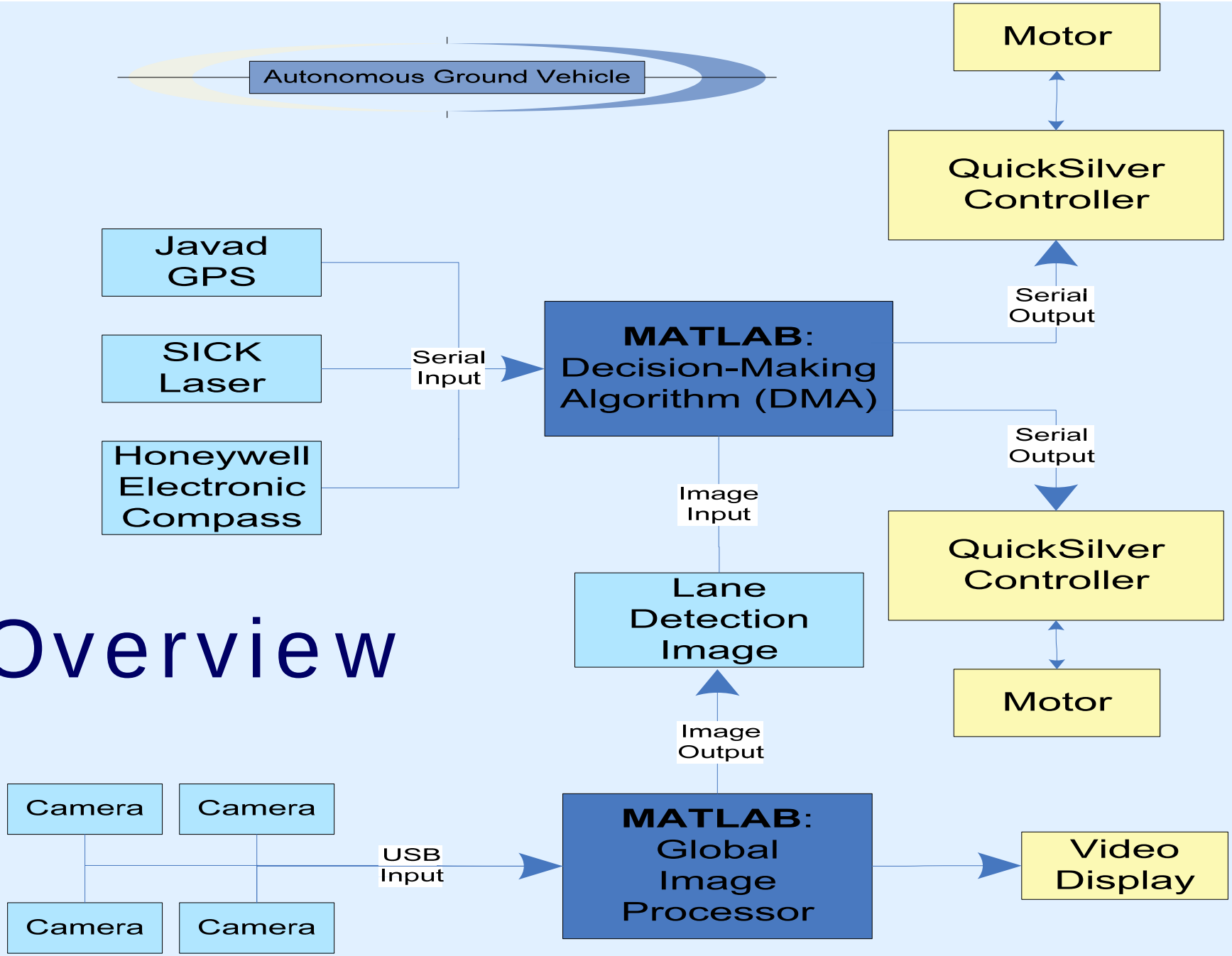
Design



Results

- Phase 2 (Spring):
  - Motion Control
  - GPS Waypoint Navigation
  - Obstacle Avoidance
  - Lane Detection
  - System Integration

Overview


Autonomous Ground Vehicle
Motor
QuickSilver Controller
Serial Output
Javad GPS
SICK Laser
Honeywell Electronic Compass
Serial Input
MATLAB: Decision-Making Algorithm (DMA)
Serial Output
Image Input
QuickSilver Controller
Lane Detection Image
Motor
Image Output
Camera
Camera
Camera
Camera
USB Input
MATLAB: Global Image Processor
Video Display

Phase II Results

- Motion Control

  It's as easy as typing in this command…..

Move 5ft forward at 1ft/s, at 1ft/s^2 on only the left wheel →

evm(5, 1, 1, motor1)

Function Name/ Movement type

Distance (ft)

Acceleration (ft/s^2)

Velocity (ft/s)

Which motor? (left or right)

Motion Control (cont.)

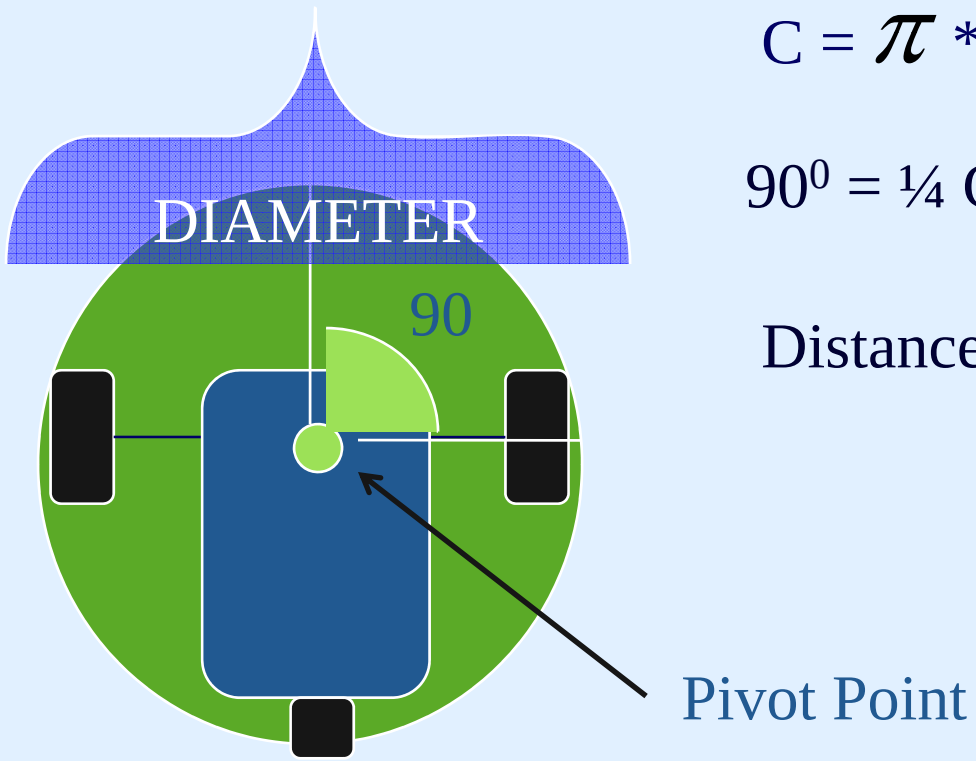
So what if we passed these commands?

evm(2, 1, 1, motor1)

evm(-2, 1, 1, motor2)

Motion Control (cont.)

What if I just wanted to turn 90 degrees to the right?



$C = \pi * D$

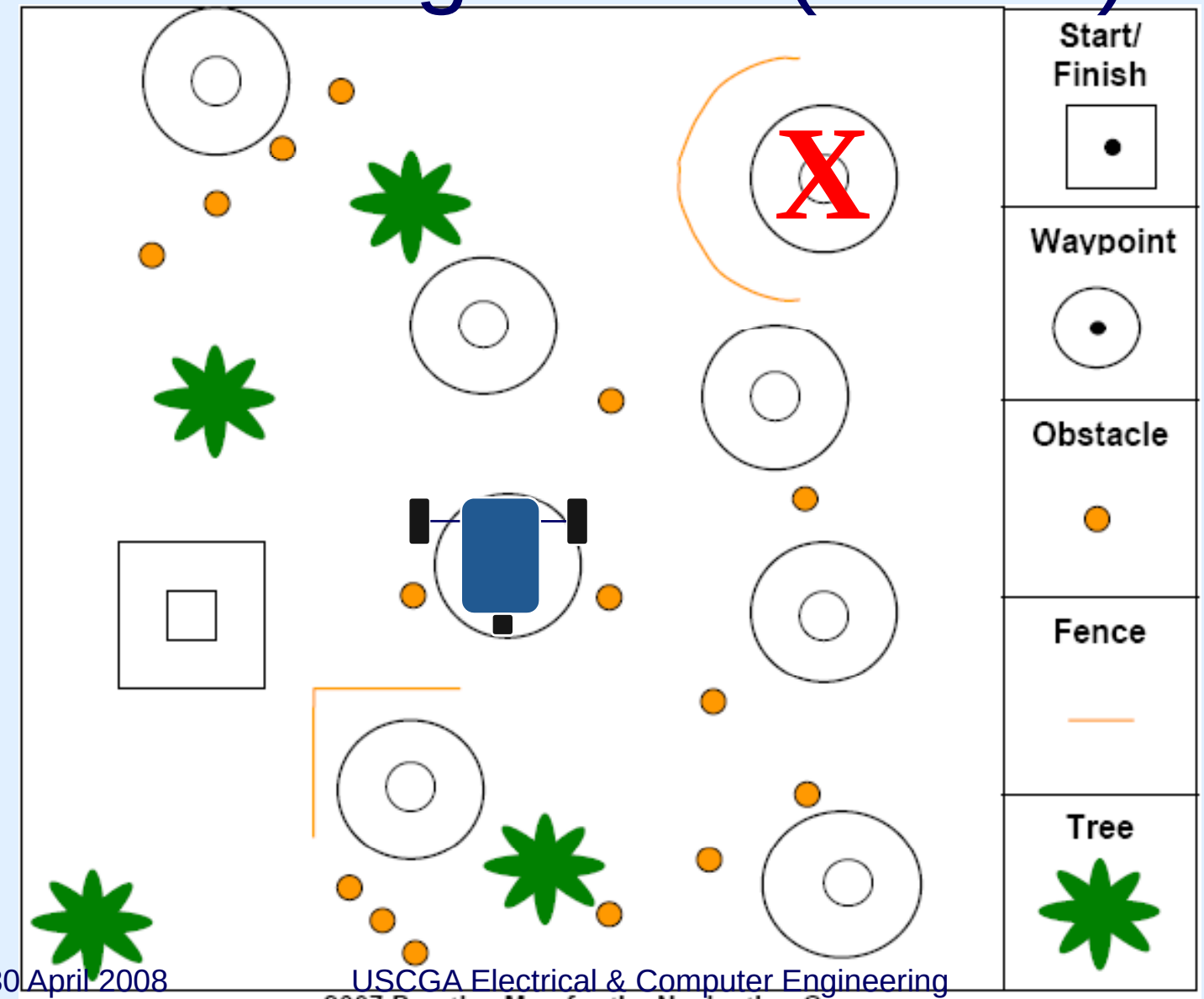
$90^0 = ¼ C$

Distance = ¼ π D

Phase II Results

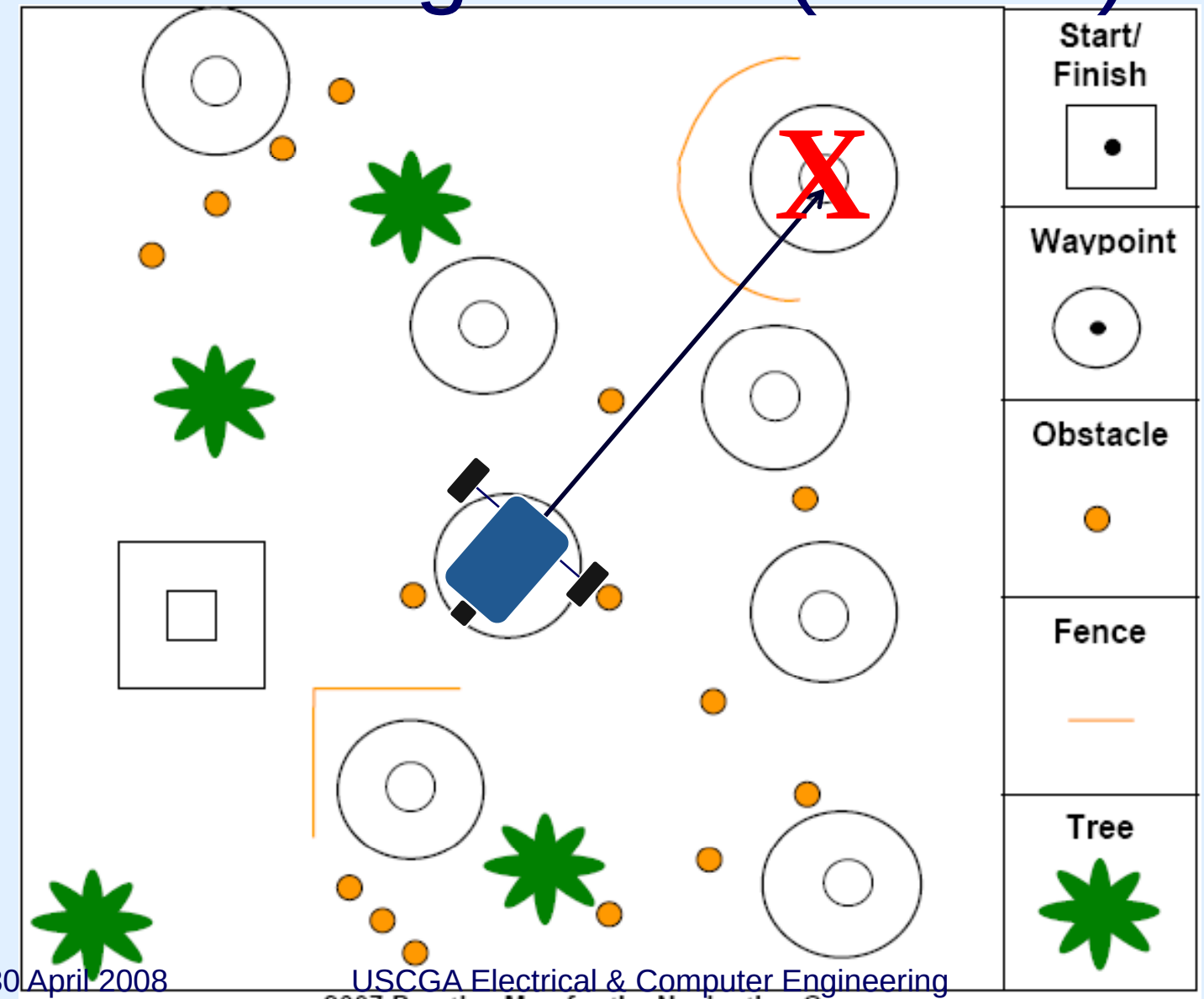
- Waypoint Navigation using GPS and Compass

Navigation (cont.)



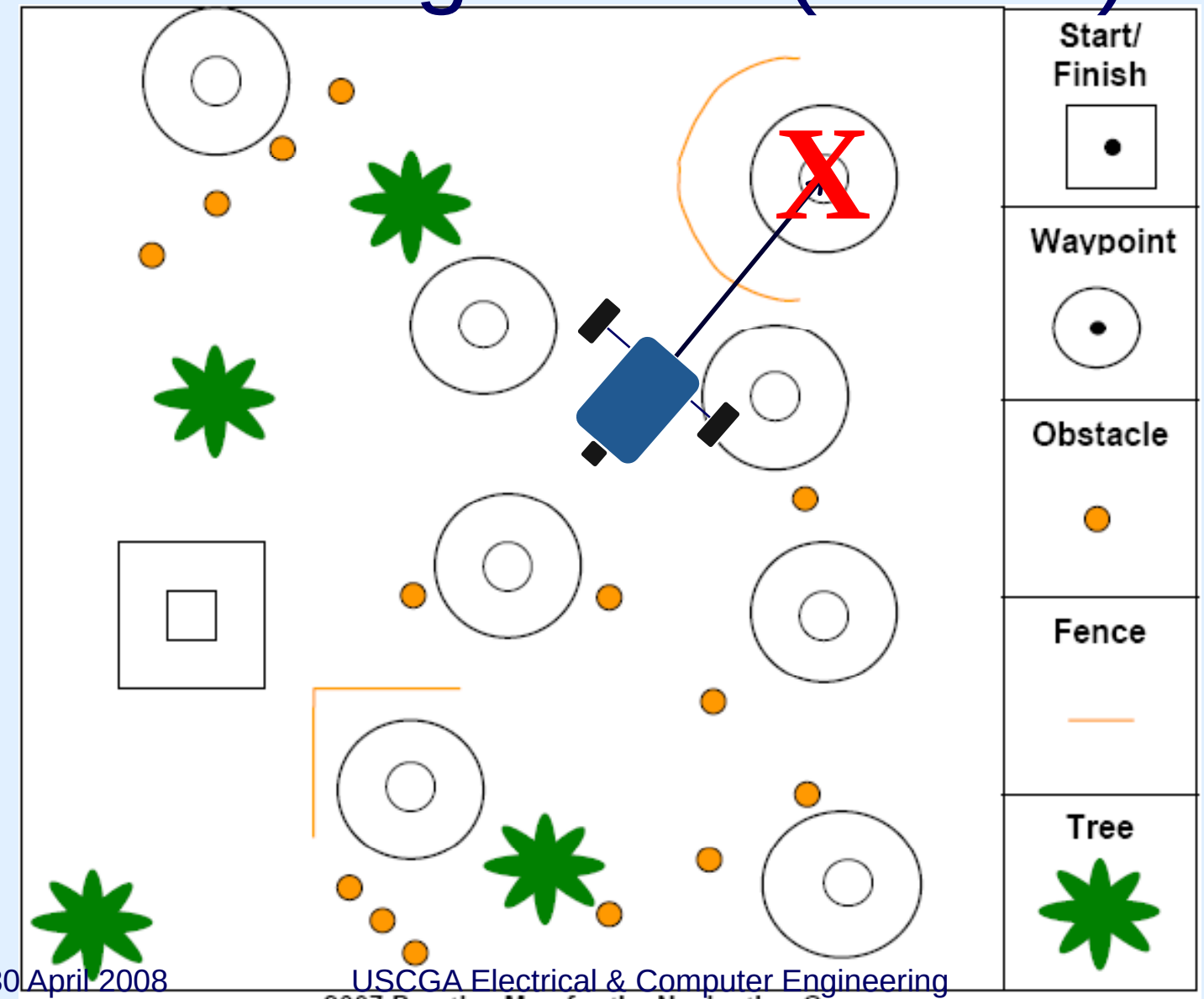
2007 Practice Map for the Navigation Course

Navigation (cont.)



2007 Practice Map for the Navigation Course

Navigation (cont.)



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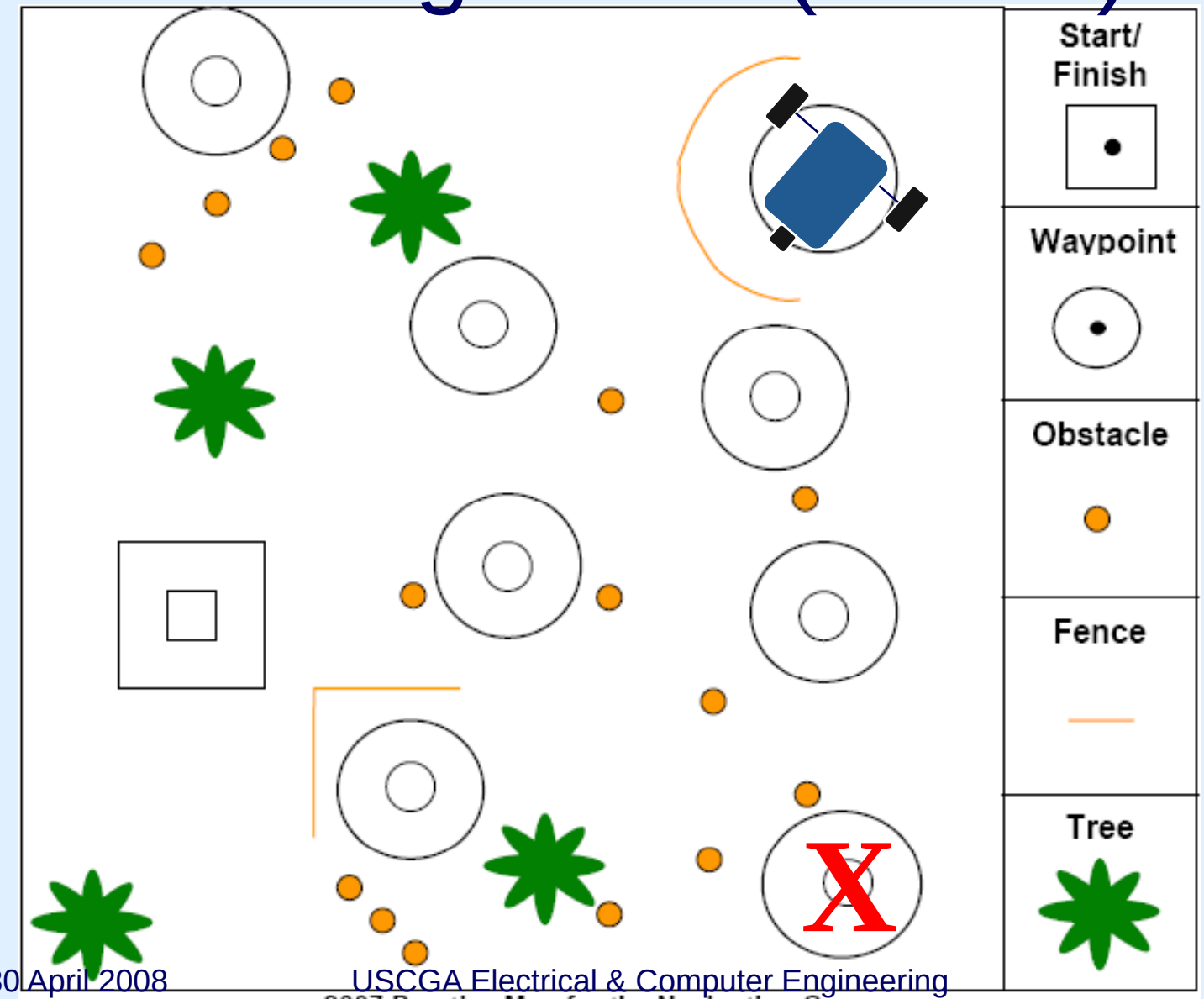
Navigation (cont.)



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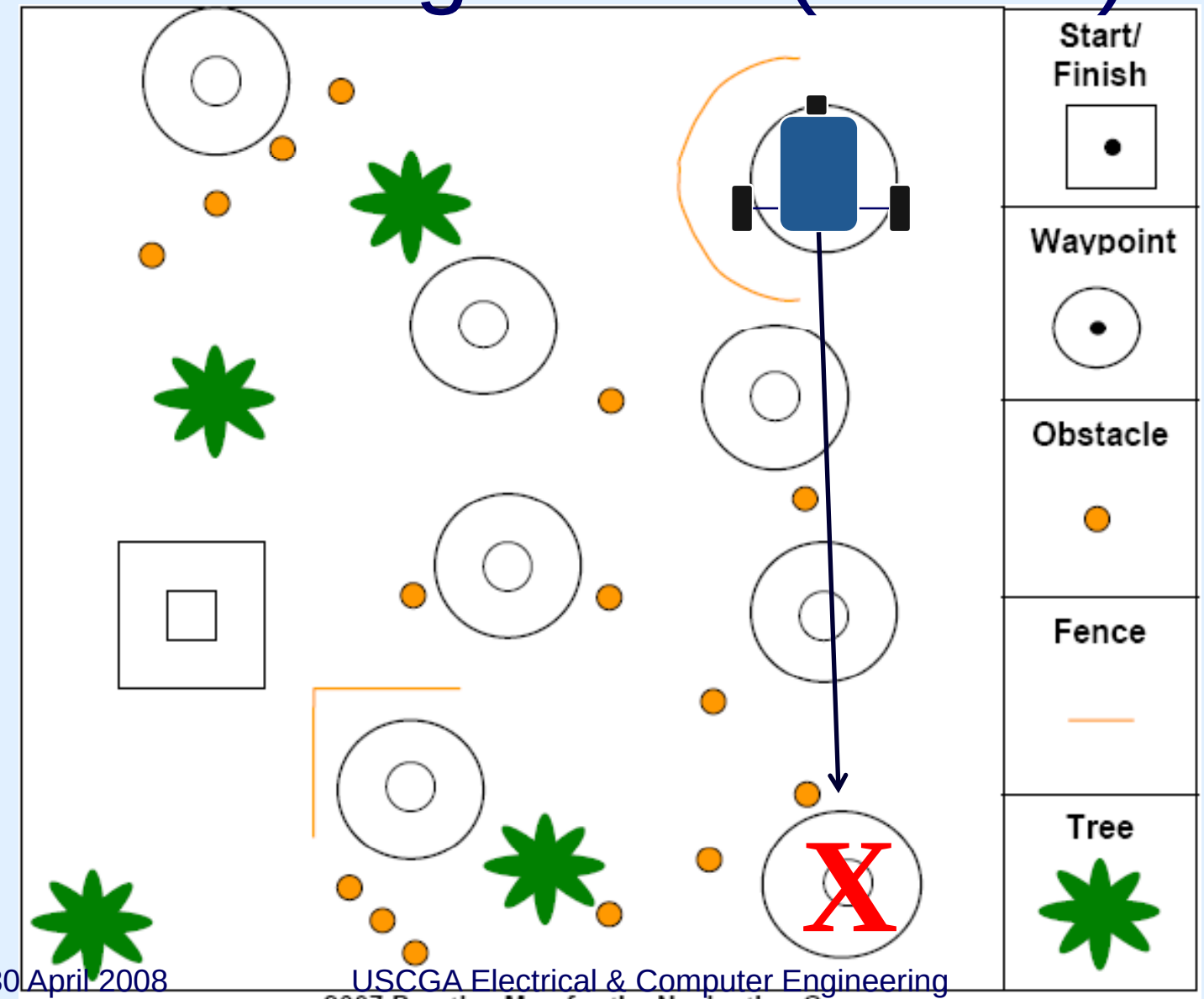

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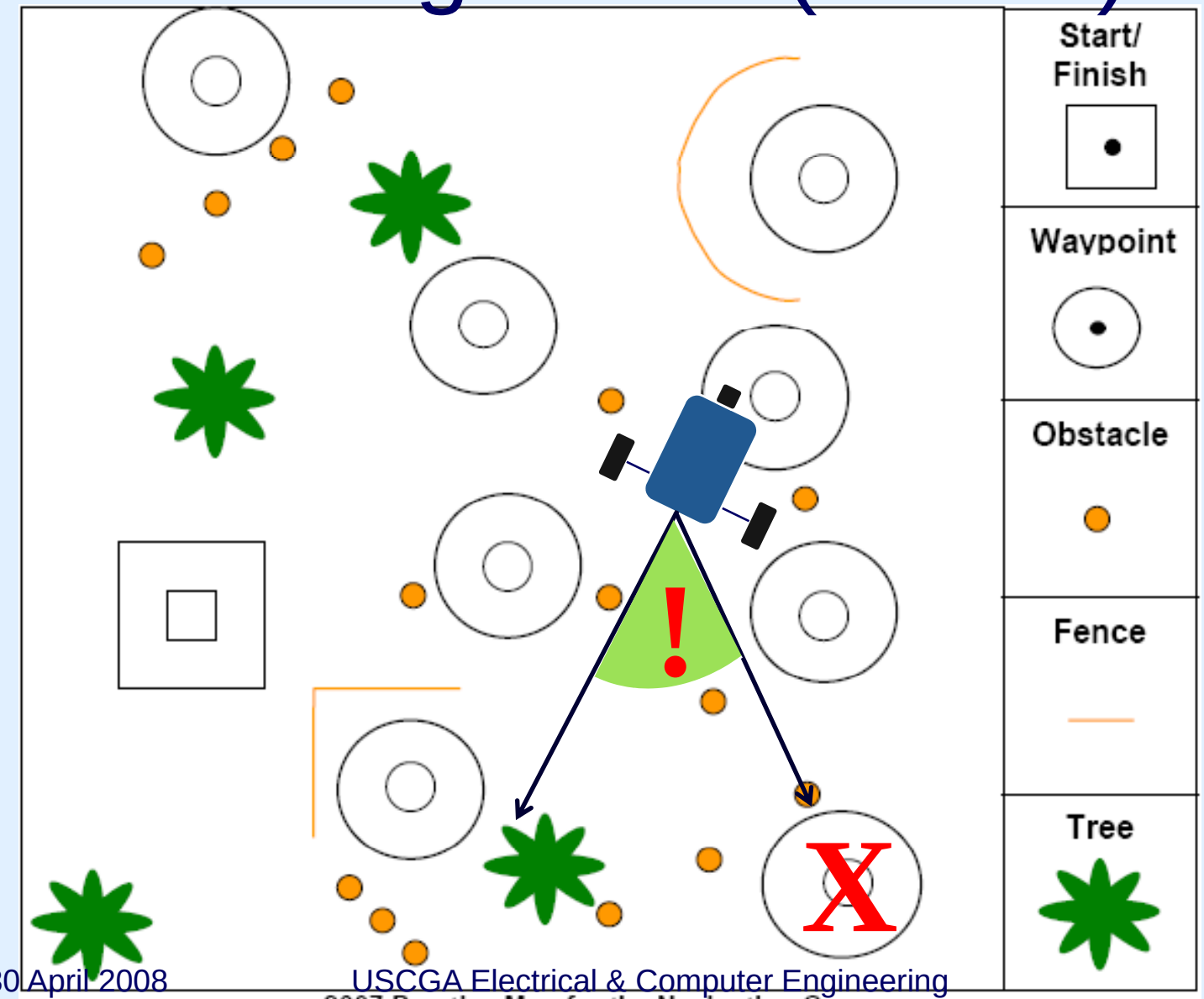

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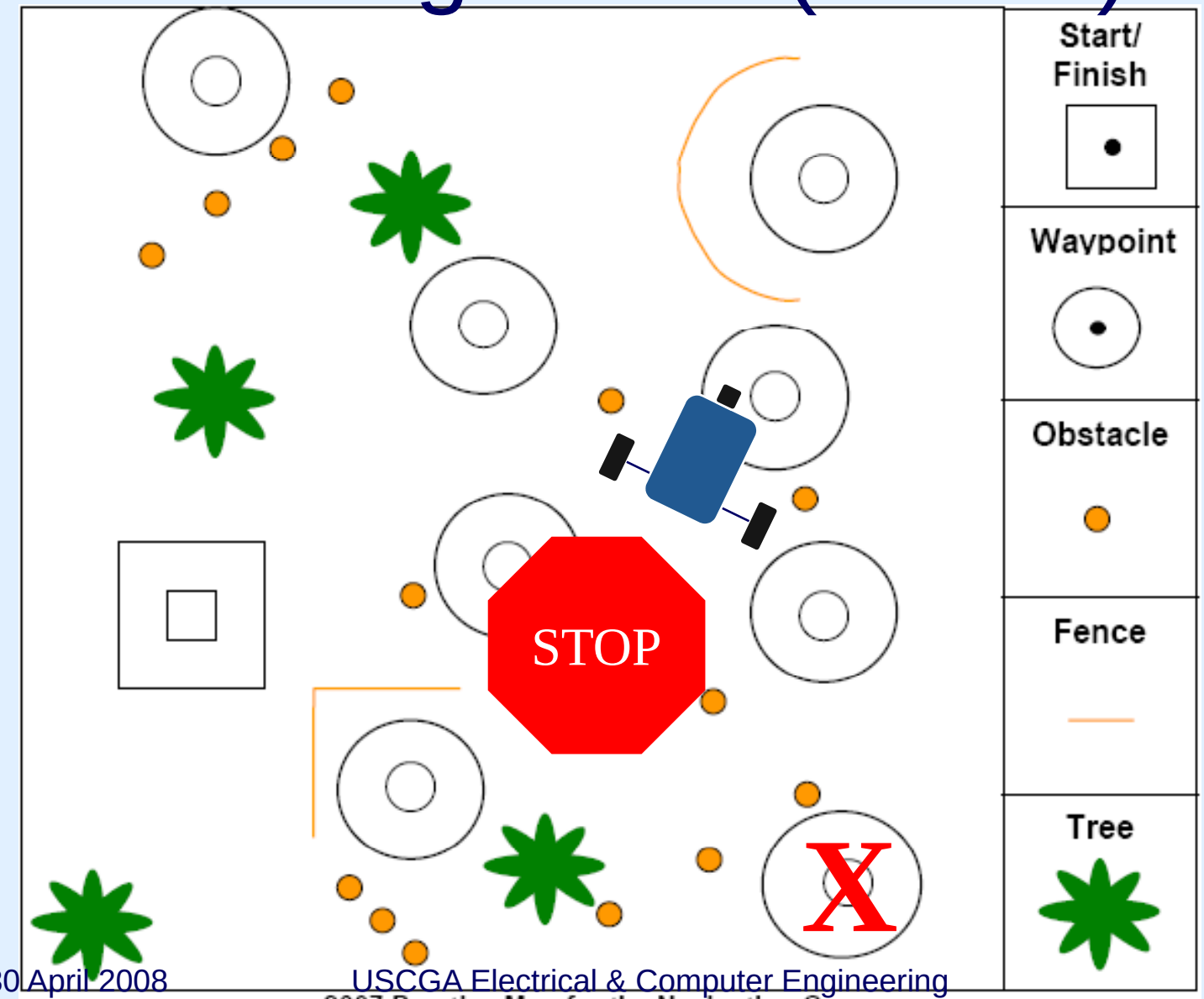
Navigation (cont.)



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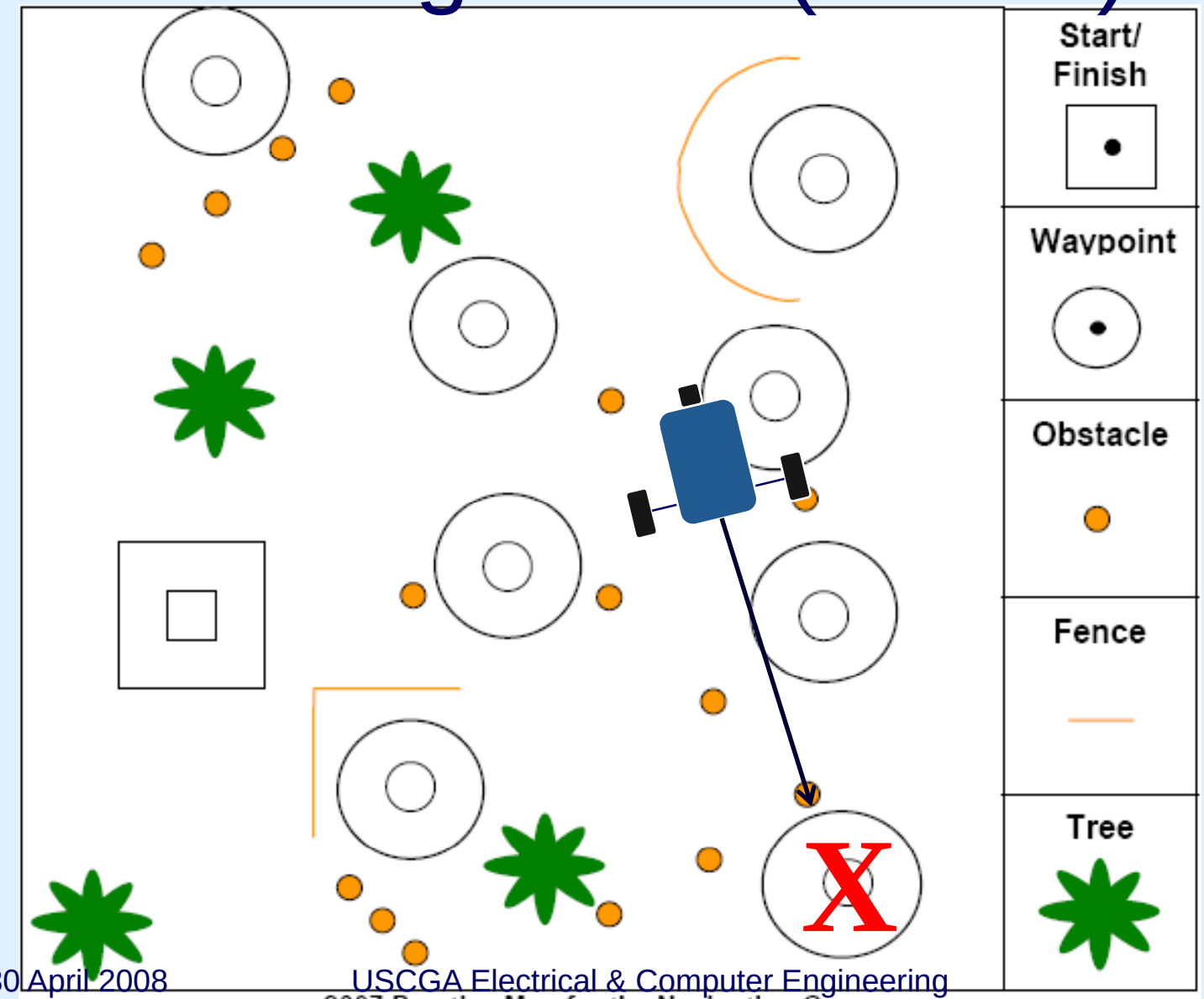

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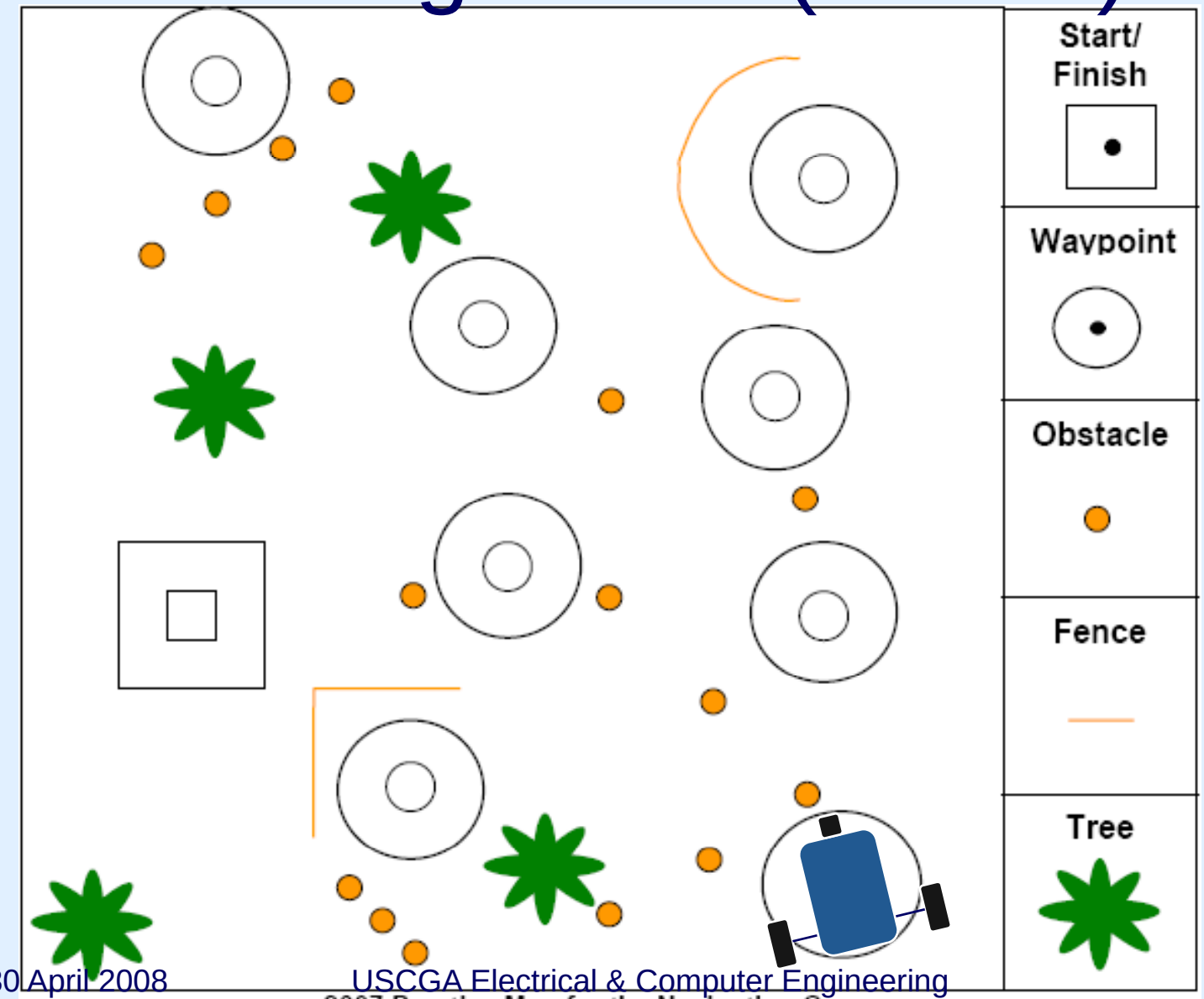
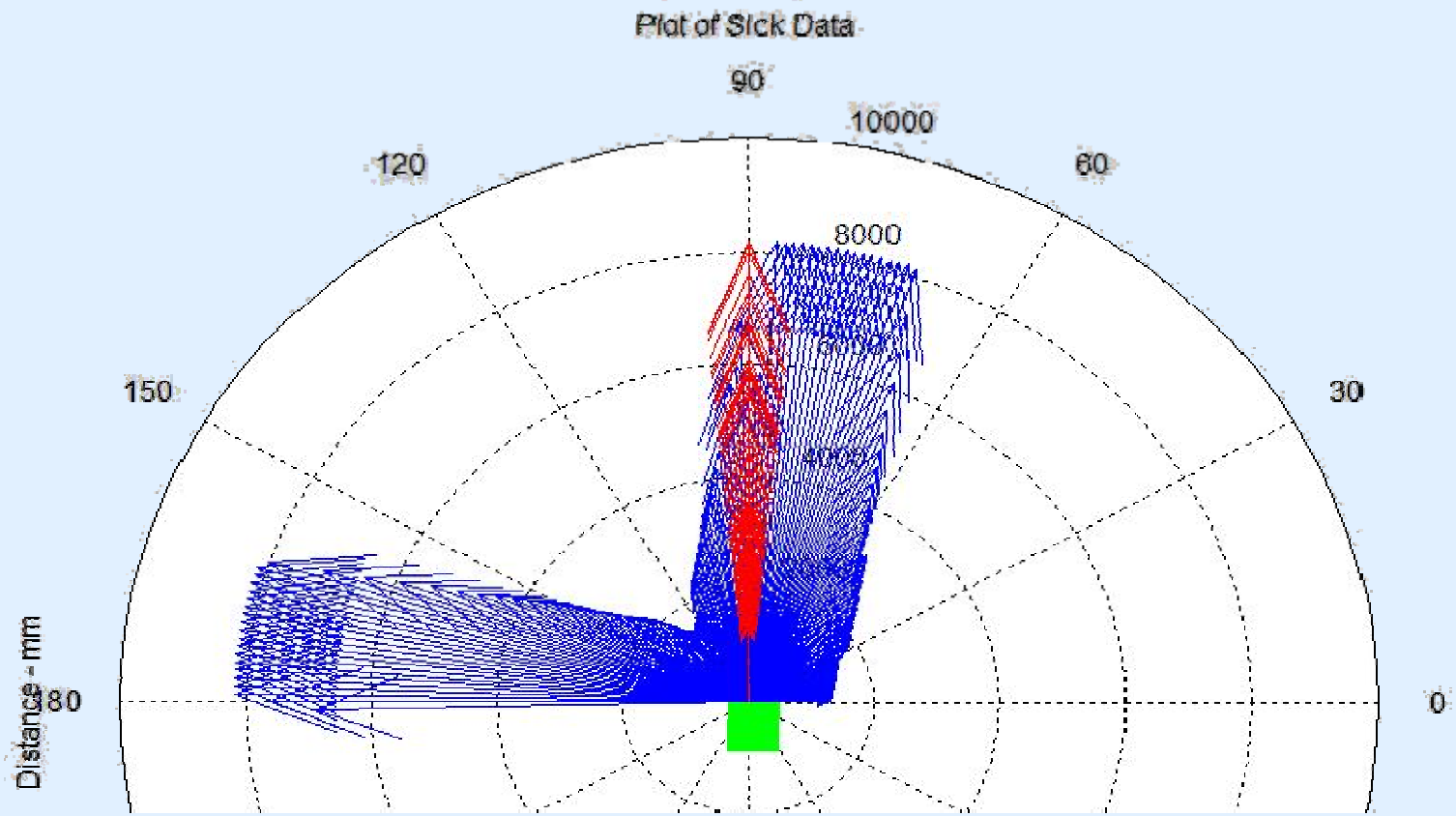
Navigation (cont.)



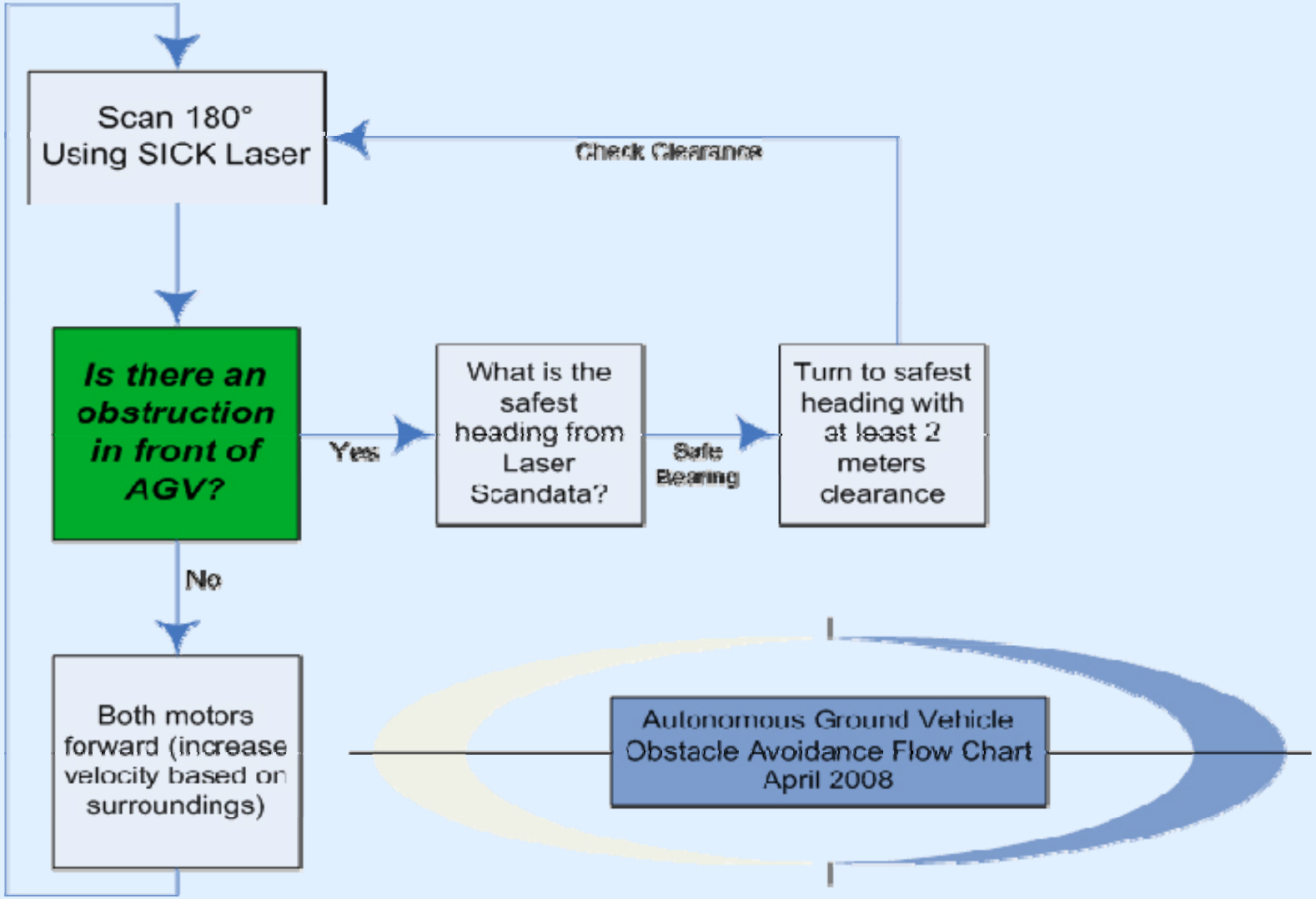
2007 Practice Map for the Navigation Course

Phase II Results

- Obstacle Avoidance

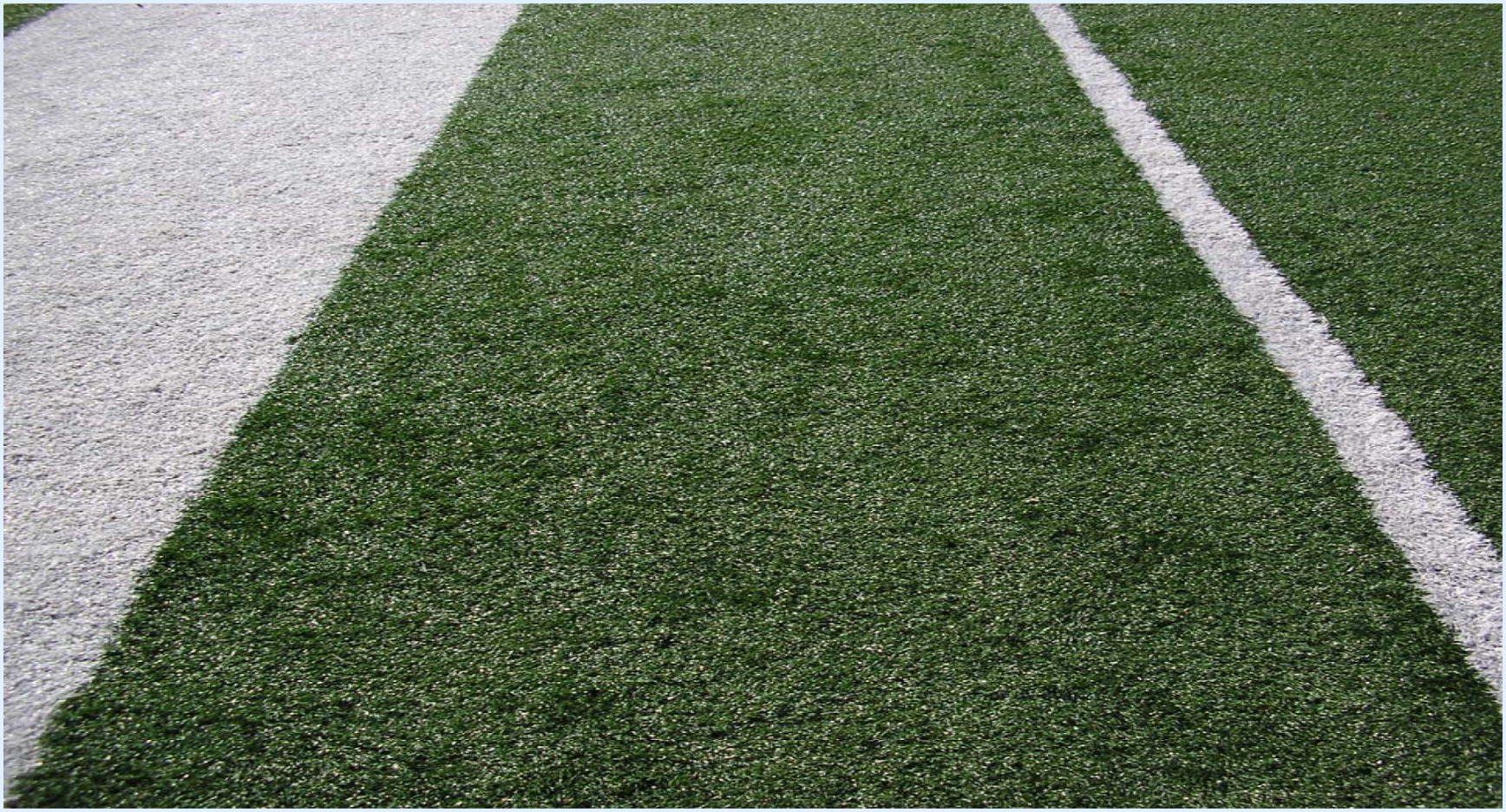


Obstacle Avoidance

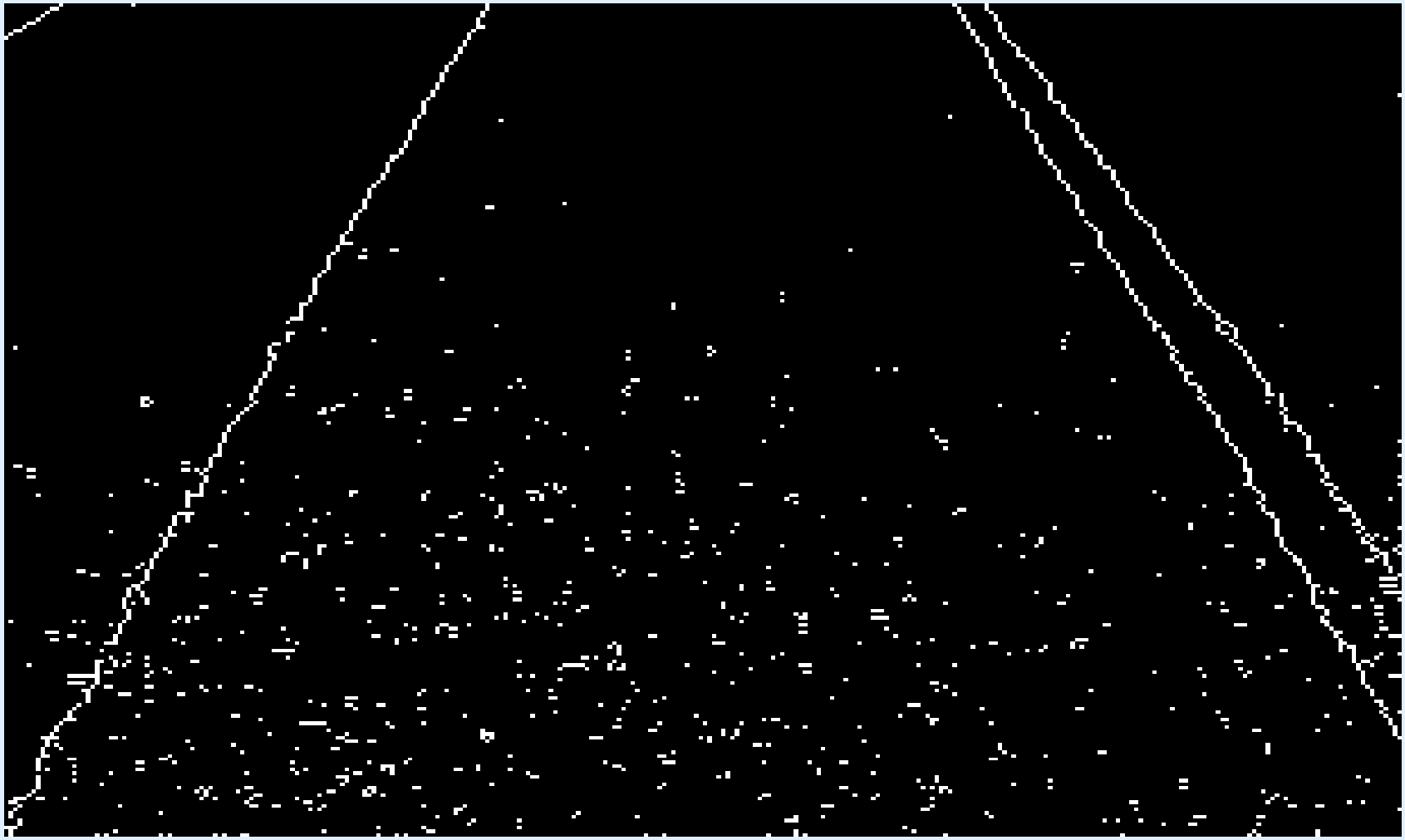


Phase II Results

- Lane Detection

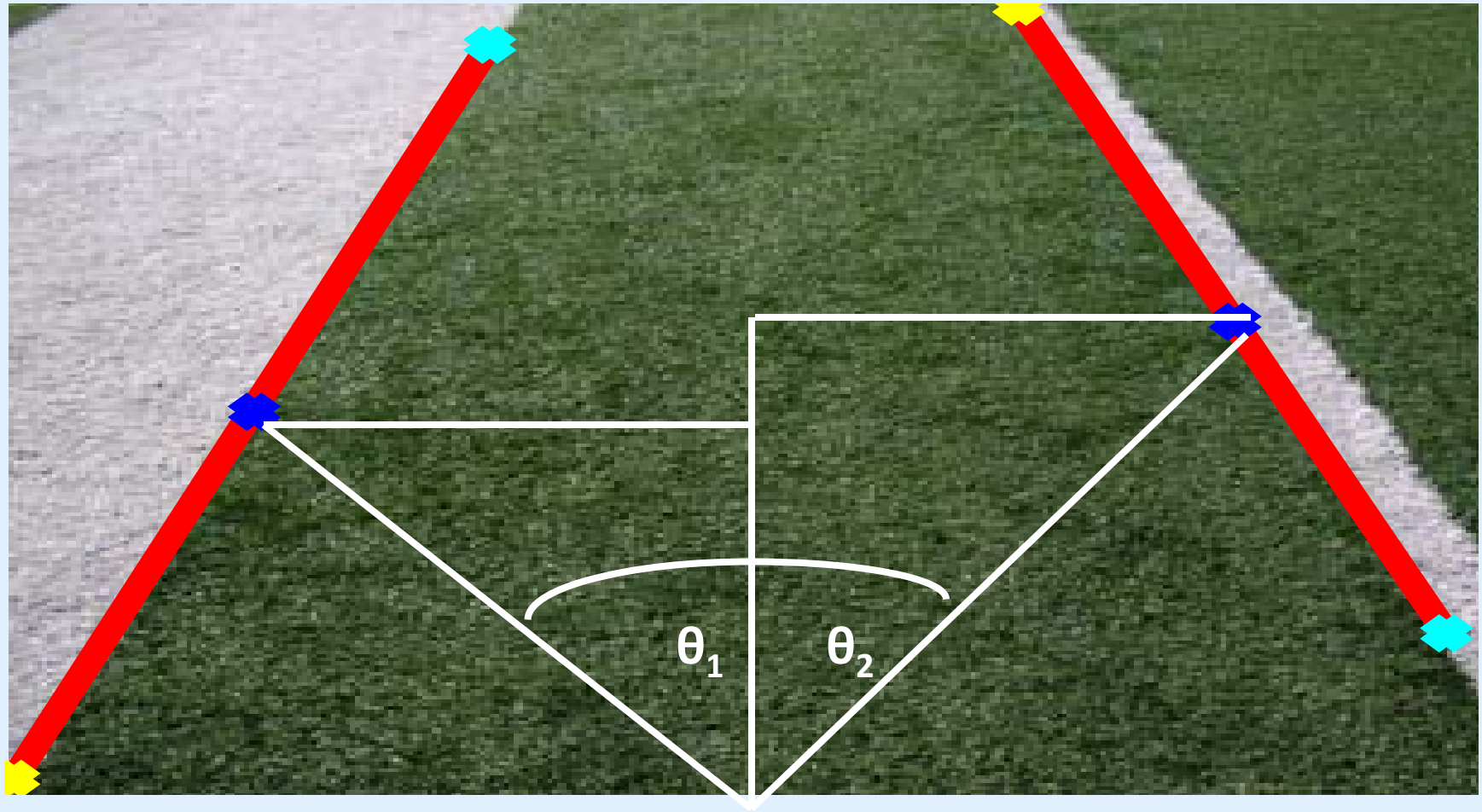


Lane Detection



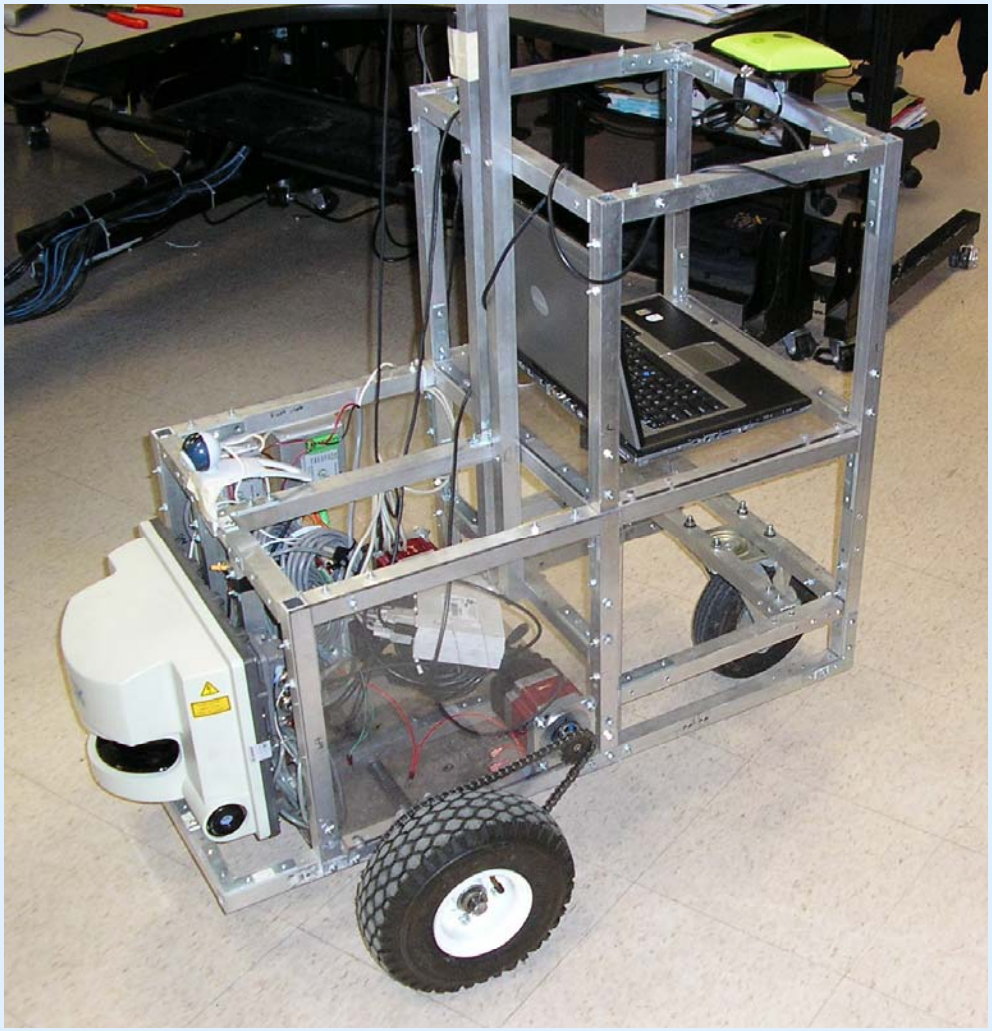
Lane Detection

- Lane Detection Continued



Phase II Results

- System Integration
  - All components are operational
  - Decision-Making Algorithm (DMA)
  - Vehicle is inefficient



What next?

- Full system integration
- Increase efficiency
- Vehicle Memory
  - LT Taylor
  - Kalman Filtering
- IGVC!

Conclusions

- The vehicle meets all requirements of the IGVC
- Next design team is set up for success

IGVC OR BUST!

Acknowledgements

- Thank you to:
  - ET2 Koula
  - SCPO O'Connell
  - Prof Swaszek
  - LT Everette
  - LT Taylor
  - CAPT Hartnett

Questions ????