FLORIDA POLYTECHNIC UNIVERSITY

EGN 4905 - Autonomous Systems Self Driving Cars

Project Based, Cross Disciplinary Course

Dr. Dean Bushey

Mar 15, 2017

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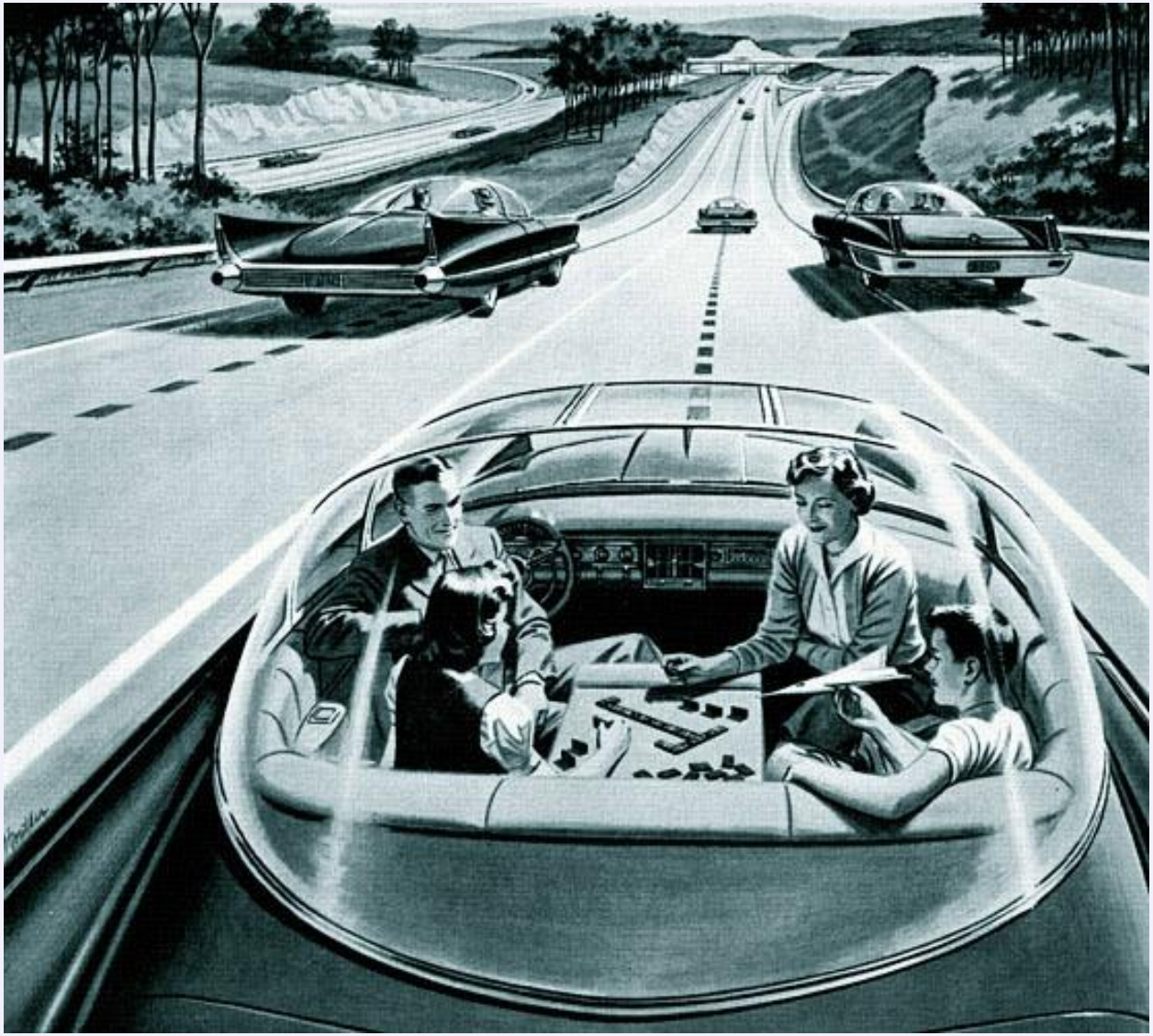
What is your vision?



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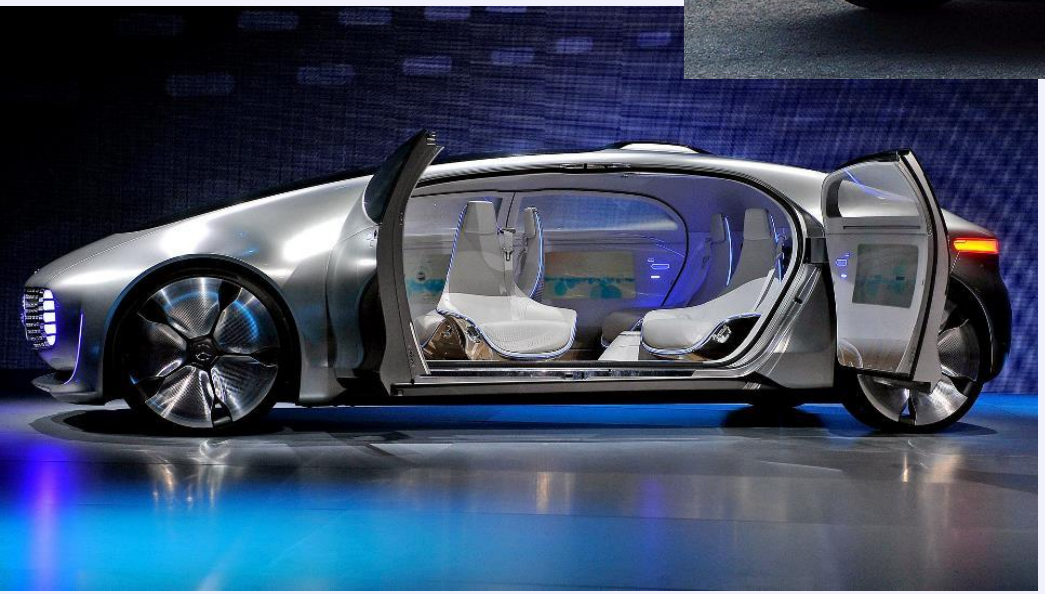

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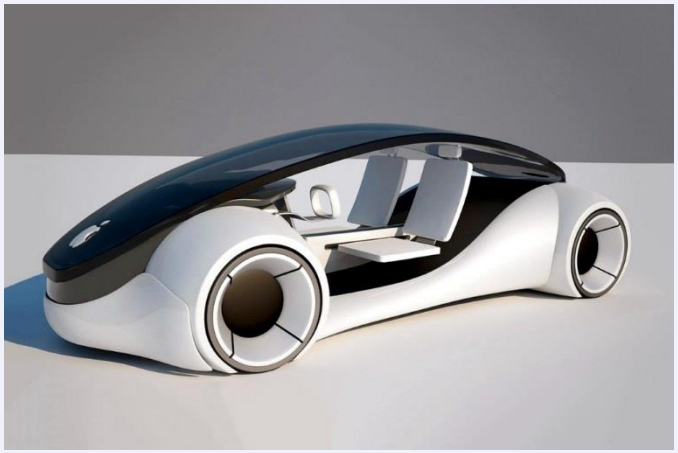

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What is your vision?

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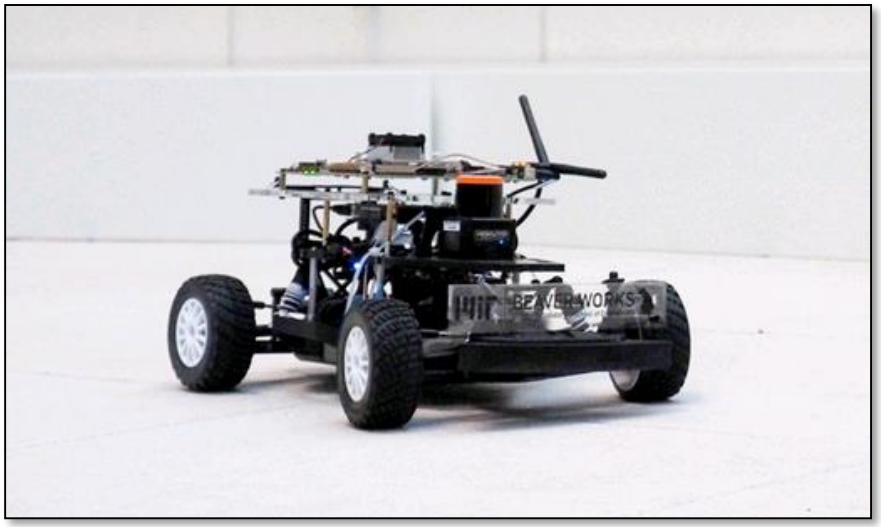
Autonomous Systems Car Course

Spring 2017 Florida Polytechnic University

Hands-on intense semester program focused on demonstrating fast autonomous navigation in complex environment (mini Grand Prix)

- **3 teams (7 students per team)**
- **Each team with RACECAR* (Sensors, NVIDIA computer, ROS)**
- ***Build…Move…Explore…Learn…Race!* In project challenges**



Demonstrate advanced capabilities of autonomous self-driving car!

*** Rapid Autonomous Complex-Environment Competing Ackermann-steering Robot**

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Course Overview

- **11 Computer Science**
- **6 Electrical Eng**
- **3 Computer Eng**
- **3 Mechanical Eng**
- **1 Transportation MS**

Engineering Independent Study –

Fills
- Elective Requirements for EE ME CE
- Software engineering requirement for CS

- **2 Freshmen**
- **10 Sophomore**
- **10 Junior**
- **1 Senior**
- **1 Grad Student**

PROJECT BASED Multi Disciplinary

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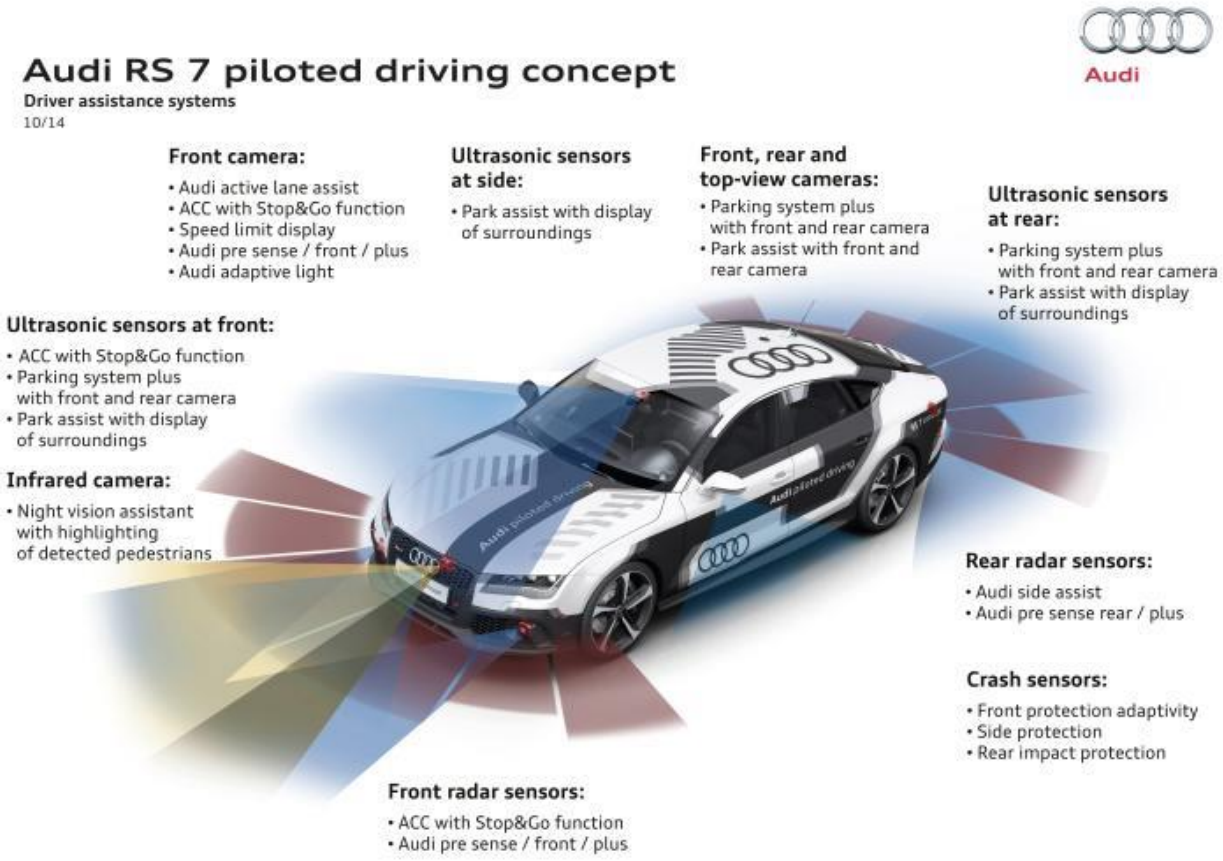
Automated/Connected Vehicle Requirements

- Diverse redundant sensors (optical, infrared, radar, & laser)
- Short range comm systems
- Long-range comm
- Navigation, mapping
- Automated controls (steering, brakes, nav, etc)
- Servers, software & power w/high reliability
- Testing, MX & repair infrastructure



REGULATORY and LEGAL FRAMEWORK – Lengthy?

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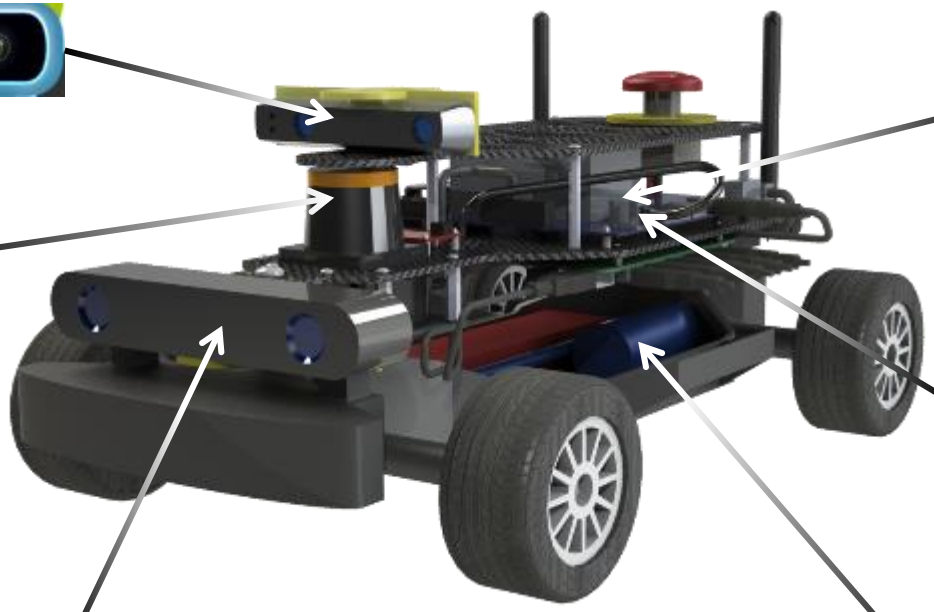
RACECAR 2.0

Structure.io
3D Scanner

Hokuyo UST10-LX
2D Lidar Scanner

ZED 3D
Stereo Camera



Sparkfun
Razor 9-DOF IMU

Nvidia TX1
Embedded Visual Processor

Traxxas Rally Car
1/10 Scale

Electronic Speed Control
(Open Source VESC)

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Syllabus Outline

Accomplished in 5 units/Challenges

- **Build:** integrate all sensors, hardware, and software

- **Move**: basic motion control & simple obstacle avoidance

  DRAG RACE

- **Explore**: vision based blob, target, & object detection

  Cone Weave

- **Learn**: mapping, localization, and road network navigation

  MAP the IST

- **Race**: brings all the pieces together for a final competition

  GRAND PRIX 

Materials drawn from prior MIT and Lincoln Lab courses

Massachusetts Institute of Technology

Build…Move…Explore…Learn…Race!

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Topics Covered

- **Autonomous Vehicle Hardware requirements**
- **Robot Operating Systems and Real Time Operating Systems**
  - Publish and Subscribe
- **Embedded Systems Control**
- **Perception**
  - Computer Vision
  - Localization
  - Mapping
- **Algorithmic Planning**
- **Machine Learning**
- **Fundamentals of Systems Engineering**

QUESTIONS?

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BACKUP SLIDES

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Candidate Research / Enrichment Projects

Projects	Research Elements
Find and chase another race car in an open environment	Object (vehicle) recognition, tracking, pursuit planning
Follow a race car with small drone	Unmanned aerial vehicle embedded systems and control
Map an indoor environment quickly and look for a hidden object	Simultaneous localization and mapping, exploration strategies
Navigate a dense set of traffic cones using computer vision only	Computer vision object (cone) recognition and obstacle avoidance
Detect markers on the ground and drive over as many markers as possible while going with a constant forward speed	Low-latency computer vision and high-speed planning
Find a parking space and parallel park with and without a trailer	Non-holonomic motion planning
Formation driving (uses spare cars)	Multi-robot coordination and planning
Push boxes between storage locations	Manipulation and high-DOF motion planning

Unbundling The Automobile

Vehicle Cybersecurity
ARGUS CYBER SECURITY
Karamba Security
VisualThreat

Connected Car
dash
REMOTO
Airbiquity
Metromile
AutoBot
Automile
TRUVOLO
cariq
carvi
AUTOMATIC
Zubie
mojio

V2V/V2X Communication
VENIAM
Savari
TTTech
RoboCV
KYMETA
Cohda Wireless
Autotalks

ADAS/ Car Automation
nuTonomy
NAUTO
drive.ai
AdasWorks
Robot of Everything
ZMP
OXBOTICA
(Comma.ai)

Engine Efficiency
ePower Engine Systems
Y.A.N ENGINES
ACAT
Pinnacle Engines
achatesPOWER
Agility Fuel Systems
Em

Auto Repair
CarZ
YourMechanic
FAYETTE FABRICATION
ClickMechanic
HONK
openbay
URGENTLY
REPAIR PAL
autobutler.dk
PITSTOP

Sensor Hardware
QUANERGY
LeddarTech
TRILUMINA
PHANTOM INTELLIGENCE

Tires
LDL TECHNOLOGY
Aperia TECHNOLOGIES
DMACK

Navigation/Mapping
INRIX
BirdsEye
swift NAVIGATION
PathSense
MapmyIndia
navmii
MAPKIN

Battery Storage
Boston POWER
QuantumScape
solid energy
envia SYSTEMS
amprius

Driver Safety
Zendrive
navdy
SMARTDRIVE
CellyDRIVE
AUGARY
exploride
lytx
HeadsUP!

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