

AGENDA CENG 5437_4391 March 1, 2022

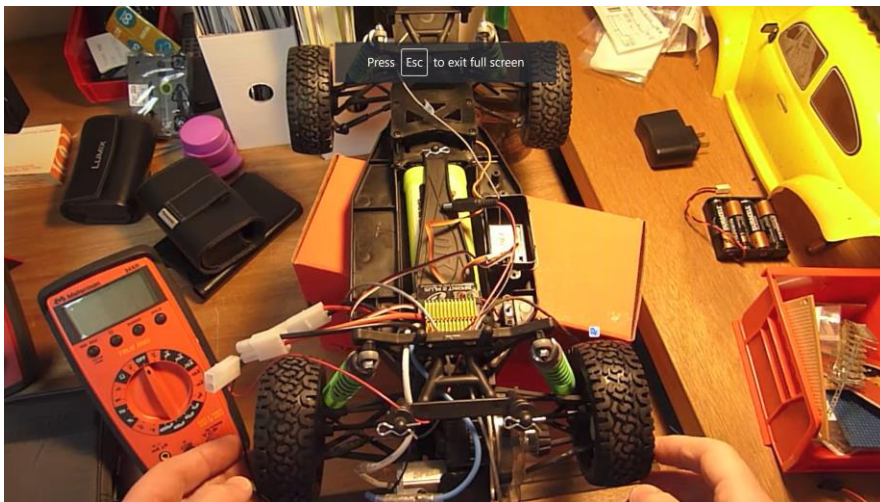
REMIND ME TO RECORD WHEN NECESSARY. Review Lecture 2/22/2022

- 1. Go Over - CENG 5437 HW 4 Mobile Robotics**
- 2. 2_5437_4391_Review2_2_22_2022a.pdf**

Robot Odometry Calibration Video

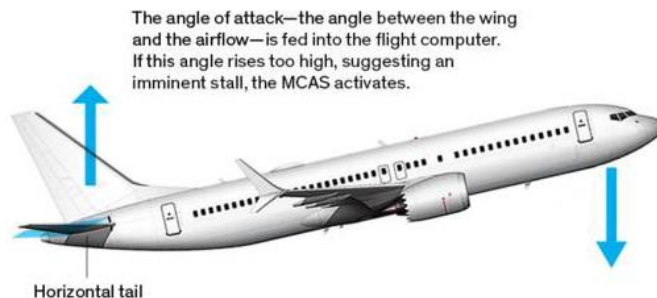
9,586 views Jun 2, 2013 6:57

<https://www.youtube.com/watch?v=qsdilZncgqo>



- 3. 3_SensorPhysicsPresentation1.pdf**
- 4. 4_Navigation_OdometryErrors&Variance2_22_2022Presentation1.pdf**
- 5. 5_MAX_737_Sensor Failurea.pdf**

Safety Item #1: USE OF SINGLE ANGLE OF ATTACK (AOA) SENSOR: Erroneous data from a single AOA sensor activated MCAS and subsequently caused airplane nose-down trim of the horizontal stabilizer.



- 6. 6_SensorsErrors2_Computers.pdf**
- 7. Videos_Feb22_2022.pdf**

Let's Drive

RADAR AND LIDAR

SensorsForSelfDrive_Videos_SP2021.pdf

How do self-driving cars “see”? - Sajan Saini

310,437 views • May 13, 2019 5:24

https://www.youtube.com/watch?v=PRg5RNU_JLk

TAKE A LOOK AT THE LIDAR AND INTEGRATED PHOTONICS TECHNOLOGIES THAT HELP SELF-DRIVING CARS NAVIGATE OBSTACLES, NO MATTER THE ENVIRONMENT, WEATHER OR LIGHT.

Elon Musk on Cameras vs LiDAR for Self Driving and Autonomous Cars

149,830 views • Apr 27, 2019 10:23

See why Elton Musk thinks Cameras are better than Lidar sensors.

<https://www.youtube.com/watch?v=HM23sjhtk4Q>

TESLA AND ELON MUSK OUTLINE WHY THEY BELIEVE CAMERAS (VS LIDAR) ARE ALL THAT IS NEEDED FOR FULL SELF DRIVING DURING THE TESLA AUTONOMY DAY FOR INVESTORS ON APRIL 22, 2019. ELON ALSO TOUCHES ON WHY THEY DON'T CONSIDER HD MAPS AND PRECISION LANE MARKINGS TO BE ELON MUSK SAYS LIDAR "IS A FOOL'S ERRAND" AND THAT ANYONE USING LIDAR IS "DOOMED."

HE GOES ON TO SAY THAT THEY ARE "EXPENSIVE SENSORS THAT ARE UNNECESSARY. IT'S LIKE HAVING A WHOLE BUNCH OF EXPENSIVE APPENDICES. LIKE, ONE APPENDIX IS BAD, WELL NOW YOU HAVE A WHOLE BUNCH OF THEM, IT'S RIDICULOUS, YOU'LL SEE." THERE QUITE A BIT OF DEBATE IN THE SELF-DRIVING WORLD WHETHER LIDAR IS TRULY REQUIRED FOR FULL SELF-DRIVING CAPABILITIES ON AUTONOMOUS VEHICLES. LIDAR PROVIDES VERY A VERY ACCURATE, HIGH PRECISION DEPTH MAP OF THE WORLD AROUND THE CAR, BUT IS CURRENTLY STILL FAIRLY EXPENSIVE AND ALSO HAS CHALLENGES SEEING THROUGH OCCLUSIONS, LIKE RAIN, SNOW AND FOG. TESLA'S ARGUMENT IS THAT ROADS WERE BUILT FOR HUMAN DRIVERS WITH VISION AND THAT VISION SYSTEMS, SUCH AS CAMERAS WILL DO A BETTER JOB TRAVERSING THAT ENVIRONMENT THAN OTHER SENSORS, READING ALL THE VISION QUEUES MEANT FOR DRIVERS, LIKE ROAD SIGNS, ETC. IN ADDITION, TESLA BELIEVES THEIR VISION SYSTEM (PLUS RADAR) ACCURATELY HANDLES DEPTH SENSING PROBLEMS AND THAT LIDAR IS NOT NEEDED FOR THAT FUNCTION.

[TI Radar Video.pdf](#)

https://www.youtube.com/watch?v=dwQm0uz_5wk

[TI radarSensors_spry311_ROS.pdf](#)

<https://www.ti.com/lit/wp/spry311a/spry311a.pdf?ts=1645772057771>

Note Table1 and Figure 7 and Figure 10 with TurtleBot2 !

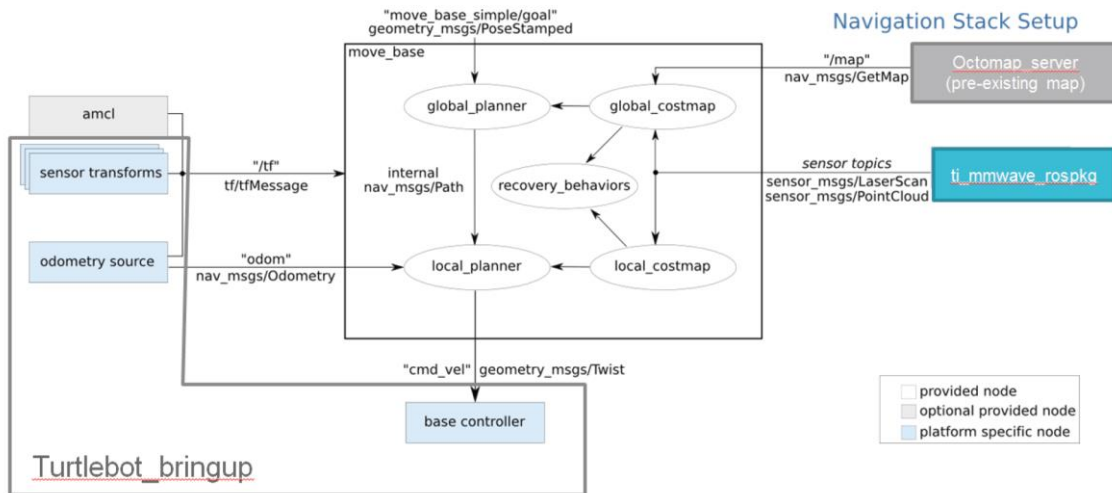


Figure 10. ROS library navigation stack used with the IWR1443BOOST-equipped Turtlebot 2.

On-vehicle radar and sensor fusion demos using TI mmWave technology

6,483 views Nov 27, 2017 4:45

https://www.youtube.com/watch?v=dwQm0uz_5wk

The Ultimate Sensor Battle: Lidar vs Radar

<https://medium.com/@intellias/the-ultimate-sensor-battle-lidar-vs-radar-2ee0fb9de5da>

But probably the main disadvantage of lidar system technology is its price. Not so long ago, a single sensor made by Google cost \$75,000. And even though the company has dropped the price by 90%, lidar sensors are still less affordable for auto manufacturers than any other kind of sensors.

Today, Google's lidar costs \$7,500 per unit. Following the company's reduction in price, many other sensor manufacturers dropped the price of their lidar sensors too (take [Velodyne](#), for example). The good news is that lidar's price will only continue to decline. And thanks to [solid-state technology](#), lidar units will become smaller and even more cost-effective.

My first Lidar for the lab cost about \$5000. **€4,782.00**



CAN WE FIX THINGS? SENSOR FUSION

Sensor Fusion

9,706 views • Jun 16, 2016 3:55 For Cars, cameras, lidar, radar Data fusion

Mitsubishi Electric Research Labs (MERL)

<https://www.youtube.com/watch?v=JamDa-qNjPI>