

LIVE IN THE CAR: INSIDE LOOK INTO AUTONOMOUS VEHICLE DRIVE MISSIONS

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WHAT ARE DRIVE MISSIONS?

DRIVE MISSIONS = PIECES OF AV SW FUNCTIONALITY THAT TEACH THE CAR TO DRIVE ITSELF





DRIVE MISSIONS: PERCEPTION

WHAT A HUMAN SEES



WHAT THE AI CAR COMPUTER SEES



HOW A DEEP NEURAL NETWORK SEES



Image

Image source: "Unsupervised Learning of Hierarchical Representations with Convolutional Deep Belief Networks" ICML 2009 & Comm. ACM 2011. Honglak Lee, Roger Grosse, Rajesh Ranganath, and Andrew Ng.

OBSTACLE PERCEPTION





PATH PERCEPTION



NVIDIA AGX PEGASUS TEST DRIVE

OCTOBER 2, 2018

80 KILOMETERS 4 HIGHWAY INTERCHANGES 10 LANE CHANGES 0 DISENGAGEMENTS



EXAMPLE: INTERSECTION DETECTION

Al-based Wait Conditions Detection



EXAMPLE: INTERSECTION DETECTION

Al-based Wait Conditions Detection



WAITNET

California Drivers

Sim

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DRIVE MISSIONS: LOCALIZATION + MAPPING



NVIDIA DRIVE Localizing to Global HD Maps







DRIVE MISSIONS: PLANNING

NVIDIA DRIVE AGX Pegasus 6-Camera Surround Perception





NVIDIA SAFETY FORCE FIELD



https://www.nvidia.com/en-us/self-driving-cars/safety-force-field/











DRIVE MISSIONS: SIM + CONSTELLATION

DRIVE MISSIONS IN DRIVE SIM

Nightly battery of tests (ex: Euro NCAP) Reproducible results SAME weather SAME time of day SAME test drivers SAME test pedestrians



Euro NCAP CCRs: Slower target vehicle Heyford Test Track, UK

SIM = RAPID PROTOTYPING

Validate functionality over 1,000s of conditions







Animals

Fog



Hazards



Clear



Cloudy





Snow

Different sensor configurations



Rain

SIM = RAPID PROTOTYPING

Validate functionality over 1,000s of conditions

Dangerous or Expensive scenarios

Permutations of scenarios

Internationalization



Pedestrians





Animals

Fog



Hazards



Vehicles

Dav





Backlit







Rain







" Autonomous vehicles need to be driven more than 11 billion miles to be 20% better than humans. With a fleet of 100 vehicles, 24 hours a day, 365 days a year, at 25 miles per hour, this would take 518 years."

Rand Corporation, Driving to Safety

NVIDIA DRIVE SIM AND CONSTELLATION AV VALIDATION SYSTEM



Virtual Reality AV Simulator Same Architecture as DRIVE Computer Simulate Rare and Difficult Conditions, Recreate Scenarios, Run Regression Tests, Drive Billions of Virtual Miles 10,000 Constellations Drive 3B Miles per Year



AUTONOMOUS VEHICLE SENSORS

Diversity and Redundancy in Data



DRIVE AGX XAVIER

World's First Autonomous Machine Processor



Most Complex SOC Ever Made | 9 Billion Transistors, 350mm², 12nFFN | ~8,000 Engineering Years Diversity of Engines Accelerate Entire AV Pipeline | Designed for ASIL-D AV

NVIDIA DRIVE AGX PEGASUS

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320 TOPS for AI Inferencing Memory Bandwidth >1 TB/s 400W

Data Center in the Trunk



DRIVE MISSIONS: CULTURE OF SAFETY

A CULTURE OF SAFETY



A CULTURE OF SAFETY

Commitment to Recognized Industry Standards



- Commitment to all recognized safety standards
- Commitment to cybersecurity
- Commitment to AI education

