Carter Delivery Robot

Introduction

[music until 1m 25s]

Jensen's Description

That's so amazing. So just imagine: this little tiny robot is navigating this really complicated [building]. There are no road signs, so it's got to figure out where it is, and where it needs to go based on a larger plan. And it tries to plan the trajectory around obstacles -- and the obstacles are changing all the time -- it's changing all the time. And the environment is changing all the time. And ideally, this robot will able to interact with you: talk with you, recognize you, and take actions from us.

Clare is going to show us a demo of the simulator. And the reason why this is so important -- as you can imagine -- is it is almost impossible to train Carter and Isaac in all of the different scenarios that will happen. And you don't want to put this robot in the real world as it's trying the learn it. And so we want to create a virtual world. A virtual world where the robot can learn how to be a robot. And in this virtual world, it has to obey the laws of physics. [The world] has to be physically real, so that when you are done, the software from this simulation brain can be downloaded right into the real robot and things just work as you expect. And so the simulator [the similator] and all of the algorithms, of course of robotics is vitally important.

And so as I previously showed you [in the Automotive section of my presentation where] DRIVE was simulating the world, and running hardware-in-the-loop, we do the same with Carter. We simulate the world and run hardware in the loop so that the software is exactly as it would be when you're done. Clare is going to give us a demonstration.

[Clare] Alright, so the reason why we are... we're going to show to a little bit more of what you've seen in is because, as Jensen explained, it's very hard to develop robots and it takes a lot of time. And with simulation we... and with the development tools that we that we can see on the left, over there, we allow you to accelerate the development cycle.

[Jensen] So this is the map. This is the map of Endeavor, and Clare and the software team -- Clare is the head of our robotic effort -- and she has to… the first thing it has to do… is Carter has to localize itself within that map. And this is trajectory planning. Red is long-term trajectory planning -- the path plan, route plan. And the Blue is the near term trajectory plan out of the algorithm LRQ. And this is the brain. This is the eyes of Carter. This is what Carter sees. This is what our robot sees. And what it sees, of course, is a simulation world. And so Clare is going to take it away.

[Clare] So let's go ahead. The Demo application that runs here on the left is really the one who executed in the past, in the video before. And there is really zero changes between the run in simulation and the run in reality. However, what's really interesting is when you start playing with simulation and you have this ability to create and generate complicated scenarios…

[Jensen] Look at this… it's replanned. Go ahead, keep going.

[Clare] .. to create, dynamically, obstacles or objects. Then the testing of the robot becomes a game, which an extremely important aspect when you know that everything that the robot needs to do requires extensive testing -- like months… years of testing. And with simulation, it becomes a game. It becomes a fun exercise. So you can see here that… everything is completely dynamic. The global planning is basically giving the overall trajectory and local planner (LQR) is in charge of avoiding obstacles. And so there is no warranty that if we were to run this again, it would follow the same route because the simulation is intrinsically random, and the objects that we are spanning out in front of Carter are changing the environment.

[Jensen] That's really terrific. Thank you, Clare. Good job!