

A portrait of Sebastian Thrun, a middle-aged man with a receding hairline and blue eyes, wearing a dark blue ribbed sweater. He is smiling slightly and looking directly at the camera. The background is a blurred indoor setting with warm lighting.

Sebastian Thrun is a scientist, educator, inventor, and entrepreneur. Sebastian is the CEO of Kitty Hawk, whose vision is to free people from traffic. He is also the founder, chairman, and president of Udacity, whose mission is to democratize education. Sebastian was the founder of X (previously Google X), where he led the development of the self-driving car, Google Glass, and other projects. He spent several years as a professor at Stanford University where he led the Stanford Racing Team, whose 'Stanley' won the DARPA Grand Challenge.

In a few years time, AI will be on everyone's career horizon according to Sebastian Thrun

FlyingCars

Will Become Reality

For scientist, educator, inventor, and entrepreneur Sebastian Thrun, the future of mobility is autonomous and will happen in a three-dimensional space. In an exclusive interview with dSPACE Magazine, Sebastian Thrun talks about why artificial intelligence (AI) will be important for all of us in the future and why flying cars are so exciting.

Mr. Thrun, you developed autonomous vehicles at Stanford, and now you're working on the flying car. What will mobility look like in 20 years time?

I envision a future where you hop into a vehicle, fly up into the air, and zip to your destination in a straight line. I want to avoid a future in which we are all stuck in traffic on the highway. My dream is for Amazon to deliver my food by air transport within five minutes of my order. The air is so free of congestion and so vast compared to the ground, it has to happen.

Everybody is talking about how the future belongs to the autonomous car. When will it start?

It's already started! Waymo, which I founded, is testing self-driving cars in many different parts of the United States, and they've just partnered with Lyft to offer self-driving cars to the public for the first time. Voyage, which was started by engineers I first

hired at Udacity, is already transporting senior citizens via autonomous vehicles around retirement communities throughout the United States. There are many more examples of self-driving cars in action around the world.

What are the big hurdles?

The biggest hurdles are still technical and they relate to all of the unusual scenarios self-driving cars encounter in the real-world. Engineers call these 'edge' or 'corner' cases, because they're so unusual, but the vehicle has to handle them properly in order to work 100% of the time. Every self-driving car engineer has to take into account bizarre events that could occur on the road – people driving on the wrong side of the highway, objects falling from the sky, animals coming out of nowhere. Handling these situations requires a lot of effort.

Millions and millions of test drive kilometers will have to be reeled off in test operation before autonomous vehicles can be put on the road. How many kilometers have to be driven in the real world, how many in the virtual world?

Simulation has become critical to the development of autonomous vehicles. In particular, simulation helps verify and validate software systems. The system can be checked by running previously recorded data in a simulator to confirm that the software handles the scenario properly. Simulation is also getting better at creating brand new scenarios from scratch, but I don't think we'll ever get away from having to gather data and using test systems in the real world.

What does this mean for car manufacturers and their suppliers?

Car manufacturers and suppliers have traditionally focused on mechanical engineering or fairly low-level systems software. These skills are still necessary, but higher-level software engineering, such as simulation and AI, are becoming critical. In some cases, it makes sense for companies to train their own engineers, in other cases it makes sense for them to partner with suppliers who have these skills.

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Sebastian Thrun



Picture credits: © Udacity

“Simulation has become critical to the development of autonomous vehicles.”

Driverless cars are supposed to be safer. What role do software developers play in making them safer and how can these developers be optimally prepared for their tasks?

A self-driving car is basically a robot. As such, it has three main functions: perceive, plan, and act. Perception systems use sensors to understand the environment. This requires a lot of software engineering, particularly in fields like computer vision and machine learning. We learn what a person or a car looks like by seeing lots of people and cars, and that's roughly how a computer learns. The planning system also primarily relies on software, especially AI and probabilistic systems. The car has to predict how likely it is that another vehicle will turn or stay straight, and then has to make decisions accordingly. The final step are actuation systems. They used to be largely mechanical but are now increasingly powered by software. Most modern steering and braking systems are powered 'by wire' through a computer instead of relying on mechanical components. Electric powertrains, which make a lot of sense for self-driving cars, are also largely run by software.

At Udacity you have a strong focus on Deep Learning and AI. Can you explain why?

Within the next 5 years everyone – including me – will use some form of AI in their job. No matter your profession – business leader, accountant, farmer, programmer, or virtually any other role – AI is on your career horizon. Healthcare is abuzz with new reports suggesting stag-

gering increases in the number of lives that can be saved by using AI. Legal and security experts are predicting dramatic decreases in online exploitation and fraud thanks to AI. Education innovators are creating virtual instructors to bring the classroom to underserved areas across the planet. Everyone, from marketers to manufacturers, is looking to the future and seeing the potential of AI. When Udacity began teaching AI online more than five years ago, much of this was still speculative. Now it's real, and we are constantly updating and expanding our AI offerings to ensure that everyone can learn these skills. Any student anywhere in the world can learn the skills required for these rapidly growing career opportunities.

What role do the established vehicle manufacturers play in development? How does the approach of the new players in the Silicon Valley differ from that of established manufacturers?

Traditional automotive companies are much better at designing and building cars than Silicon Valley startups. But the automotive industry can be very slow. The big advantage of new companies is speed. By developing new technology quickly and safely, new entrants to the automotive market are pushing the entire industry to become more agile and improve the world.

Back to your vision of the flying car. What are the advantages of going up in the air? And is this a dream that will be affordable for many some day?

I am so excited for flying cars. They open up so many possibilities that are not possible on two dimensional roads. When I first started working on self-driving cars, people thought I was crazy. But now self-driving cars are a reality. Today, when I tell people I'm building flying cars, they also think I'm crazy. Faster than you can imagine, flying cars will become a reality. ■

Mr. Thrun, thank you for talking to us.

About Udacity

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