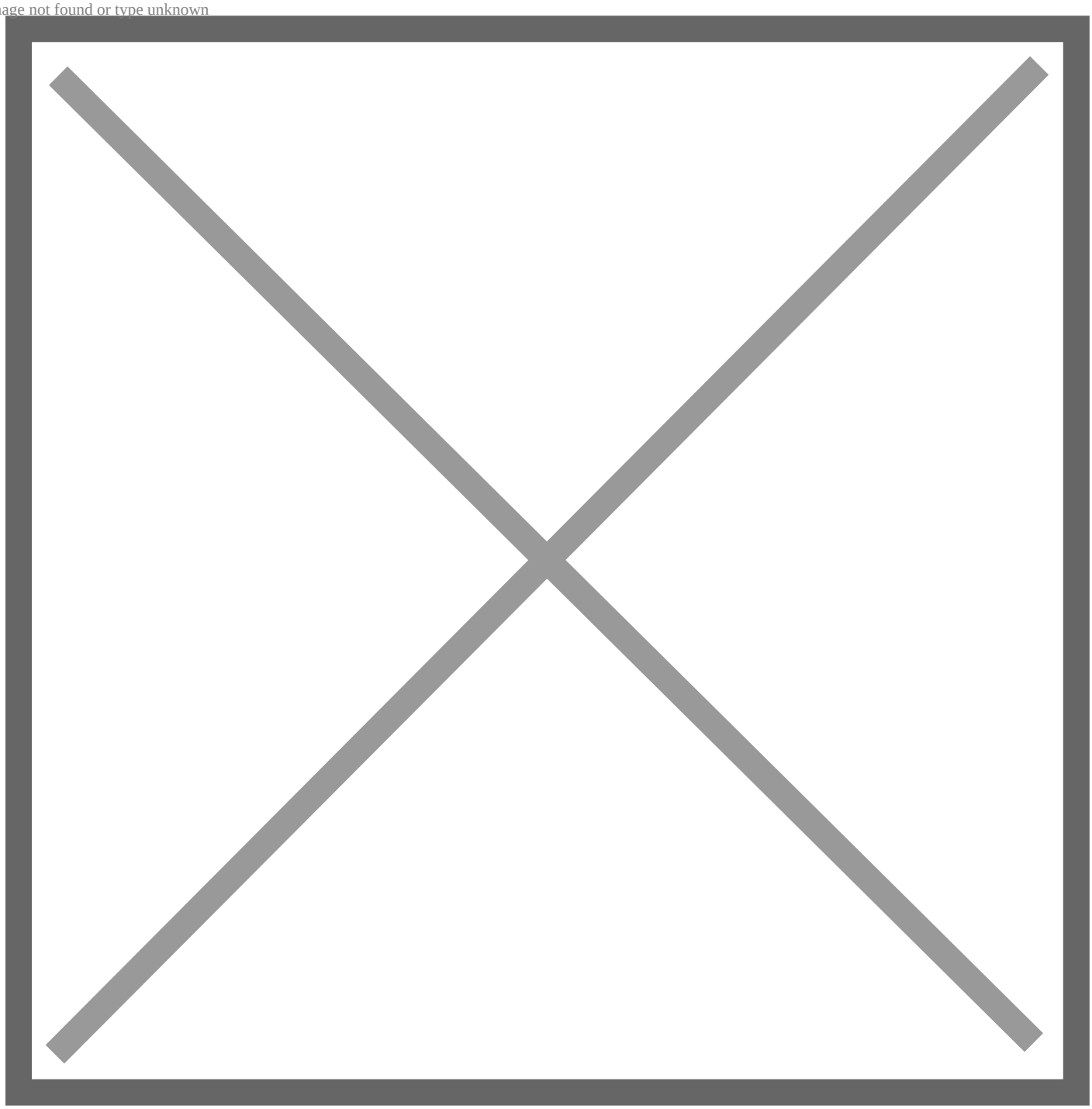
2016 Consumer Electronics Show (CES) Press Conference - Dr. Gill Pratt

January 05, 2016

Image not found or type unknown



DR. GILL PRATT REMARKS: CES 2016

HIGHLIGHTS

"Up to now, our industry has measured on-road reliability of autonomous vehicles, in the millions of miles, which is impressive. But to achieve full autonomy we actually need reliability that is a million times better. We need trillion-mile reliability."

"In 1933, Toyota recognized that the world was changing. While our company was making fabric looms…automobiles were defining the future."

"Toyota has traditionally been a hardware company because in the past the most important technology for enhancing human mobility was hardware. The old joke, is that Toyota is the world's best manufacturing company. They just happen to make cars. Times have changed, and software and data are now essential components of Toyota's future mobility strategy."

"It is entirely possible that robots will become for today's Toyota what the car industry was when Toyota made looms."

"Home robots may be even more personally prized in our future than cars have been in our past."

"TRI will enthusiastically pursue collaboration with other OEMs, IT companies, suppliers, research labs, and universities to jointly develop autonomy technology."

"Toyota's goal is to move people across the room, across town, and across the country."

"People have reasonable fears about whether technology will work in their best interest, or if it is competent to do the jobs we assign. We need to be sure that the autonomous agents given the power to make decisions are capable of being audited. We can't trust what we don't understand, so we must build cars that can explain their actions."

"Most of what has been collectively accomplished has been relatively easy because most driving is easy. Where we need autonomy to help us, is when the driving is difficult. And it's this hard part that we intend to address."

As prepared for:

2016 Consumer Electronics Show (CES)
Las Vegas, Nev.
Tuesday, Jan. 5, 2016
Dr. Gill Pratt, Toyota Executive Technical Advisor and Chief Executive Officer of Toyota Research Institute (TRI)

Thank you Bob, and thank you everyone for coming.

Only 4 months ago, we announced that Toyota would invest $50 million dollars to support artificial intelligence and robotics research at Stanford and MIT.

At the time, we promised that Toyota was just getting started, and that there would be much more to come.

Two months later, we announced the formation of the Toyota Research Institute – TRI – a new research and development company focused on the application of artificial intelligence to mobility, and funded by an initial 1-billion-dollar investment. Today I'd like to tell you a little bit more about what we're going to do with that billion dollars.

Although the industry has made great strides over the last five years, we are a long way from the finish line of fully automated cars.

Tomorrow, when you look across the CES displays, at what is currently being tested and developed, you will find that these systems can only handle certain speed ranges, certain weather conditions, certain street complexity, or certain traffic.

Despite the progress you will see, most of what has been collectively accomplished has been relatively easy because most driving is easy.

Where we need autonomy to help us, is when the driving is difficult. And it's this hard part that we intend to address.

Up to now, our industry has measured on-road ***reliability*** of autonomous vehicles, in the millions of miles, which is impressive.

But to achieve full autonomy we actually need reliability that is **a million times better.**

We need trillion-mile reliability.

Every year, Toyota sells about 10 million vehicles around the world. Each travels about 10 thousand miles per year and lasts about 10 years.

That means that the roughly 100 million Toyota cars and trucks in service at any given time travel a total of about 1 trillion miles per year.

That's a large number of miles. Even if a very small percentage of that driving is difficult, that percentage times a trillion equals many miles of difficult driving that we must address.

Society tolerates a lot of human error. But we expect machines to be much better. We expect them to be ever-ready and nearly perfect.

Thus, the technologies we develop have to work not only at the Million-mile scale, but at the Trillion-mile scale.

To address this problem and leverage AI for other uses, TRI has four initial mandates:

- First, we wish to enhance the safety of automobiles with the ultimate goal of creating a car that is incapable of causing a crash, regardless of the skill or condition of the driver.

- Second, we want to increase **access** to cars to those who otherwise cannot drive, including people with special needs and seniors.

- Third, we plan to help translate Toyota's expertise in creating products for outdoor mobility into products for indoor mobility. In other words, Toyota's goal is to move people **across the room…across town…and across the country.**

- Finally we hope to accelerate scientific discovery by applying techniques from artificial intelligence and machine learning particularly in the area of materials science.

We are moving quickly as an entirely new company. We are opening for business this month in two locations – one in Stanford Research Park in Palo Alto, California, the other in Kendall Square, in Cambridge, Massachusetts.

The facilities are a short 10-minute bike ride and walk to Stanford and MIT, respectively, and we expect many researchers with ties to both institutions to work at TRI. We plan to invest in the future in other universities around the world as well.

We have started nearly 30 initial projects. Stanford and MIT will each make public the list of their research projects, but I'd like to briefly describe two of them with you now.

First, a team at Stanford will be working on a project called **"Uncertainty on Uncertainty."**

What does "Uncertainty on Uncertainty" mean? Well, it's one thing to teach a car to respond safely to events that we expect to occur – what to do if a cyclist suddenly veers into the road, for example.

Much more challenging, though, is teaching a car to respond safely to events that we haven't anticipated.

Let's say we hadn't thought of the need for a car to avoid debris falling off a truck. Should it think of the debris like another car?

Well, kind of – but the debris might suddenly break apart into many pieces.

Should it think of the debris like a pedestrian?

Well, kind of – but the debris might initially be moving at high speed.

To address this challenge, the Stanford team will be augmenting machine-learning with new methods that **generalize competence** to handle the unanticipated.

I'll spare you the math, but they'll work to measure the robustness of automated vehicle systems not only against risks that are known, but risks that haven't been seen before.

As I hope you can appreciate, it's a very important project.

The second example matters just as much. A team at MIT will be leading a project called **"The Car Can Explain**," which is all about teaching machines to tell stories.

Autonomous technology strives to be perfect.

How do we proceed to that critical point where the car is incapable of causing a crash?

When a car does something unexpected, it will need to provide unambiguous explanations of what happened…and why.

People have reasonable fears about whether technology will work in their best interest, or if it is competent to do the jobs we assign.

We need to be sure that the autonomous agents given the power to make decisions are capable of being audited.

We can't trust what we don't understand, so we must build cars that can explain their actions.

Finally, let me say a little bit about our future efforts in advancing scientific discovery, particularly in **materials science**.

Humans have been discovering new materials since prehistoric times. But the pace of advancement is held back by the speed of human intuition and experiment.

Toyota's interest in finding new materials is keen, from those that can increase the strength and lower the weight and cost of cars… to materials that can improve the efficiency and lower the cost of fuel cells. We aim to utilize computation and machine learning to accelerate scientific discovery in this area to lower the cost and improve the performance of future mobility systems.

At this point, I want to introduce a few of the initial members of our outstanding technical and advisory teams that will lead TRI.

Our initial technical team directing research will include, in alphabetical order:

- Former Bell Labs department head and DARPA Program manager Larry Jackel, who will work on machine learning.
- Former DARPA Program manager Eric Krotkov, who will be our Chief Operating Officer.
- James Kuffner, CMU professor and former head of Google Robotics, who will be our area lead in cloud computing.
- MIT Professor John Leonard, who will work part time in the field of autonomous driving.
- Hiroshi Okajima, Project General Manager, R&D Management Division, Toyota Motor Corporation, who will be our executive liaison officer.
- MIT Associate Professor Russ Tedrake, who will work part time in the field of simulation and control.

These six research directors are with us today and will join us later for a roundtable discussion.

We have already hired around a dozen or so other technical people, and the number is growing every day. Stay tuned.

TRI will be advised by a board that will include some of the world's deepest thinkers in Technological Innovation. I'll just highlight three of them today, in alphabetical order:

- Emeritus MIT Professor Rodney Brooks, former director of the MIT Computer Science and AI Lab, founder of iRobot and Founder, Chairman and CTO of Rethink Robotics
- The Honorable Richard Danzig, former secretary of the US Navy and expert in cyber security

- Yann LeCun, Director of artificial intelligence at Facebook

- John Roos, former CEO of Wilson, Sonsini, Goodrich and Rosati and former US Ambassador to Japan. Currently, General Partner at Geodesic Capital, a late stage venture capital firm and Senior Advisor at Centerview Partners, a preeminent mergers and acquisitions advisory firm. He is an expert in technology innovation in Silicon Valley.

The entire technical and advisory teams will be confirmed and announced soon.

We're collaborating from within the Toyota family as well, including;

- **Toyota Technological Institute** in Chicago;

- the **Toyota Research Institute of North America** in Ann Arbor, Michigan;

- and **Toyota Central Research and Development Labs** in Nagakute, Japan.

Clearly, we are gathering the best and brightest people at TRI to work on specific technologies with specific goals and limitless applications beyond automotive.

But Bob Carter made an important point earlier about identifying your goals and figuring out how to get there as quickly as possible.

At Toyota, we believe that when good ideas are shared great things happen.

For example, we see a ***Hydrogen Society*** in our future that goes WAY beyond automotive.

To that end, we are sharing our 5600 patents in this area at no charge to accelerate the pace of ***Hydrogen technology development.***

In the same way, TRI will enthusiastically pursue collaboration with other OEMs, IT companies, suppliers, research labs, and universities to jointly develop autonomy technology for safety and accessibility.

And there is much to be accomplished.

Let me close with some Toyota history to put this all in perspective.

In 1933, Toyota recognized that the world was changing. While our company was making fabric looms, automobiles were defining the future. The company did an incredibly brave thing – it used capital from its loom business to start in a new business – automotive.

TRI reflects a similar understanding. Toyota has traditionally been a hardware company first and foremost because in the past the most important technology for enhancing human mobility was hardware.

The old joke, is that Toyota is the world's best manufacturing company. They just happen to make cars.

But times have changed, and software and data are now essential components of Toyota's future mobility strategy.

Furthermore, the need for machines to assist in mobility has broadened from outdoors to indoors, fueled by our aging society and the remarkable progress in electronics that has expanded the realm of what is possible.

This is why TRI is working to transform mobility from outdoors to indoors.

Home robots may be even more personally prized in our future than cars have been in our past.

TRI's goal is to the bridge the gap between Research and Development – to make a real difference in what products Toyota produces in the future.

It is entirely possible that robots will become for **today's** Toyota what **the car industry was** when Toyota made looms.

That is a great challenge, and we are excited today to begin.

Thank you.