Interview with Dr. Peter Neuhaus, a senior research scientist at IHMC (The Institute for Human and Machine Cognition) on TEAM IHMC ROBOTICS from Pensacola, FL. TEAM IHMC scored eight points with a time of 44:28 in the Challenge. They used a Boston Dynamics, Atlas robot.

Q: So, your team is finally back home and settling back down now that the competition is over.

A: All the people on the DRC team are at home or taking a couple of days off, or continuing travels in California. I'm just collecting my thoughts and taking some mental health days. We all worked pretty hard, especially toward the end of the project leading up to the finals.

Q: I'm sure you did. That is a lot of work. How did you get interested in robotics?

A: I was a mechanical engineer in my undergrad and then I went to grad school. I was interested in controls but I liked the more hands-on part of mechanical engineering roles, specifically with robotic hardware. First, I taught after graduating with my masters. I realized that I could always go back to teaching, but you can only stay out of graduate school so long before it's really hard to return. So, I got my PhD. In that interim, I switched advisers from masters to PhD and went to a more hardware and design route. I graduated and worked at a factory automation company. I was interested in robotics and automation and software there, putting it all together. I then came to Pensacola where it was more research-based robotics. It was a slow progression. There was not one particular event that drew me into the field.

Q: It sounds like it was a long road to get where you are now in robotics.

A: I guess it was destiny then, as there were a lot of options to branch off instead of continuing on this path.

Q. How and why did you get involved in the DRC?

A: The Challenge is kind of a natural project for our group in terms of legged locomotion. It was a great opportunity to merge the different research that we do. We are a soft money based organization. There aren't many opportunities in which a funded program is very closely aligned with our research interest in legged locomotion and human-machine interface. This (the DRC) was one of them.

Q: What was your part? How did you contribute?

A: I did some of the software design on the human interface and our scripting. We were able to pre-record generic motions and then play them back for the (robot) operator for repeated activities like opening a door or (operating a) drill. I did some of the mechanical design of the modifications for driving. We were allowed to do passive modifications to the vehicle to facilitate the robot to drive the vehicle. For Atlas especially, the robot did not exactly fit in the driver's seat and couldn't stop on the pedal, so we had to do some mechanical design for that, as well as grabbing a steering wheel. I also managed the group in terms of finances and made program-level decisions.

Q: A lot of work.

A: Yes, this enabled Jerry to bury his head in the code base and stay focused.

Q: How did/does your robot or technology stand in comparison with the others?

A: There were seven 7 Atlas robots (at the DRC). In comparison to the other Atlas Teams, we really did not have an opportunity for changes other than the vehicle modifications and the hands. Most teams used the provided hand from Robotiq. A few opted to put a special tool on one of the hands.

Then, the big differentiator is our software. I think it's more than just our algorithms for walking and balancing. We wrote our own instead of using the ones provided by Boston Dynamic. And our software practices — we have pretty rare software practices. We have a huge code base with 20 people all developing code. We have to watch out that someone doesn't break functionality while trying to develop new functionality or fix something. We do a lot of unit testing in our software. These consist of unit tests on small tools to end-to-end tests of walking from point A to point B in simulation, and ensuring that the robot actually makes it to the final destination. That itself becomes a unit test.

Q: How closely does the simulator software come when compared with the actual motors, gears, and legs walking, and the robot's ability to balance?

A: We have our own simulator called the "Simulated Construction Set" which was written by Jerry in his graduate days. It's a physically realistic dynamic simulation. We used that as our simulation environment to develop our controllers. And these are identical to the ones we run on the robot. It's a pretty powerful development tool.

For the VRC (DARPA Virtual Robotics Challenge), we were required to use Gazebo as the simulation environment. There were bugs in Gazebo's simulation in terms of how they modelled certain ground contacts. Some teams were able to take advantage of that in the virtual robotics challenge. You could "lay on the ground" and "wiggle your joints," then all of a sudden propel yourself forward.

You didn't have to walk for some of the tasks. You could just vibrate on the ground.

Q: That was a wonderful, but odd bug you found.

A: It was problematic because they were constantly fixing bugs in the simulation, but at the same time break some other functionality. At the very end, we were not able to sit on the seat of the vehicle because the ground contacts would keep making and breaking every time we had small changes in the force. It would push us like a conveyer belt off the seat. We would have to stand while driving.

Ground contacts are hard to model in simulation. In our Simulated Construction Set, we don't do surface to surface, we only do point to surface. So, we have a much more limited ability in our software to do collisions, but we control those collisions in a better way than Gazebo.

Neither simulation goes down to the actuator level because there are too many degrees of freedom in your simulation. They barely made it real time in the VRC — a cloud-based service. We run at 3/4 real time in our simulation, but if we were to add dynamics for every actuator, it would bog it down. We typically don't include the fingers because they add a lot of dynamics that slow the simulation down. There is limited fidelity between the simulation and the robot.

Simulation is an important tool for us. We do a ton of development in simulation. We fix control bugs through developing tests in simulation. For example, we noticed on a robot when we put a foot down, we wouldn't have a secure contact and we would see the foot kind of slide before we finished making contact. We would think we were in the old spot and our support polygon would be different, and we would fall over. In simulation, we would produce that behavior of the foot getting shifted and not stepping where we thought it was by applying a force before touchdown, and were able to see the same behavior in simulation as we did on the robot. The robot would fall down. We then fixed our controller to detect that condition and saw it fixed in simulation. We created a test case with that task fixed in simulation and it would work on the robot. It's an invaluable tool. Without simulation, we would be at a huge disadvantage.

One other critical aspect is our logging capability. Every time we do a run, we use three HD cameras aimed at different angles of the robot. The video streams of those cameras go into a logging computer that also logs all of our controller variables and state variables. About 10,000 variables get logged at a kilohertz, including HD streams. After a run, if something happened we go to the log file and then we can watch exactly what happened, in video as well as in simulation. It's really helpful if you see that as a joint is wiggling, you can see an oscillation in your sensor data. We'll watch the video.

If we don't see the joint wiggling with that same motion, then we know that there is some disconnect between the sensor and the actual link.

Q: How many hours went into your DARPA Robotics Challenge effort?

A: Let's see, definitely more than 30 man years of effort.

Q: I suppose as you got closer to the event, the hours per person went up.

A: Right. It would ramp up to where people were working 60 hours per week pretty regularly, and toward the end, maybe 80 hours per week. Definitely weekends.

Q: How much money did the team spend from start to finish on this project?

A: It's probably at least a $4-1/2 million effort. If you want to add in the hardware costs, then it's about $2 million per robot.

Q: In preparation for the competition, how many hours per week did you personally work on the robot?

A: Probably about 55 hours per week toward the end of the project.

Q: What is the hardest part about the challenge in general?

A: Egress was the part that really challenged us. You watch it and like, there's no way it's going to work. It did work and ended up being pretty reliable, but it took us a lot of development to get to that point.

Q: Just getting out of the vehicle?

A: Right. The other which was minor but very important was turning on the cut tool. We were given two tool options and decided to use the cut tool. It has a button that you have to press to turn it on. It's a pretty hard task to do. You don't have a lot of tolerance for error for pressing that button. We wanted to do it with one hand in case we broke a finger or an arm doing some previous task. We ended up developing a tool that would clip onto the hand and as you grabbed the cut tool, it would turn the drill on automatically. That was a pretty challenging mechanical design making us sweat for a while trusting that it would work. The drill was a close second to the egress.

Q: What did you think of the other robots in the competition? Was there a robot on another team that impressed you?

A: I thought that (Carnegie Mellon's Tartan Rescue) Chimp was a really great design of a robot. If there was one robot that I would take into a disaster zone, I would probably take Chimp. He was the only robot that got up from a fall. It looks like it can handle different scenarios and still withstand some pretty tough conditions. It could roll on two treads and "walk" on a crawl gate, go up on three and swing one, and repeat that.

Q: What would you have done differently?

A: Maybe we would have started preparing for some of the tasks earlier. We could have done more mechanical things to help egress. But having done egress in the typical way, we can leverage that in the future.
Had we picked a better set of footsteps, we would not have fallen on the terrain. You could argue that if we had better automation checking our footsteps, we would have caught that footstep planning error and would have not fallen.

Q: What comes next for you and your team?

A: After some rest? NASA has announced a space robotics challenge and that is something that we would like to be involved in one way or another with the Valkyrie.

Q: Do you mean NASA's Fembot?

A: Exactly. The one that was in the trials. We've worked with Valkyrie. We've had Valkyrie in our lab. If you saw it (walk), that was basically our walking code on Valkyrie at the expo. We hope to continue that work and in some way stay involved with NASA robotics and the space robotics challenge.

Q: Where do you see robotics going in the next 10 or 20 years? How do you think these robots that competed on Saturday will affect the future of the military, or the future of mankind?

A: I think we'll see (more) robots or automation in self-driving cars. A lot more robotics in terms of factory production, as in the Amazon robots packaging and sorting. And it will work its way into the home. I think we're still a ways away from where it's affordable or even possible to have a robot do your dishes or fold your laundry.

Q: The robots these days seem to be one-tasked: one to sweep the floor, another to wash it, and still another to clean the windows. The general-purpose robot does not seem to be around the corner based on anything that I have seen.

A: Right, if you look at the capability in terms of manipulation and planning and locomotion, we are still a ways away from where people would tolerate that kind of performance in their house.

Q: How close are we to truly 100% autonomous "Terminator-like" robots that will take over the world?

A: Many years. As you saw, no one had to do anything and a lot of robots fell. So, if you wanted to make a robot fall, imagine how easy it would be to go out there and thwart a robot.

Q: A simple push?

A. Right. A simple push, a wire across the door. There are tons of ways to thwart the mobility or thwart the sensors — a can of spray paint on a camera or LIDAR. It wouldn't take much.
Also, they (robots) need some sort of energy. Atlas could run about an hour and a half on a 50 pound battery pack.

Q: So, a truly autonomous biped robot is what? Ten years away?

A: I think the first application will probably be a military application. Only because of cost. We are still 10 years, I think. I mean, look at Big Dog. That program has been going five years already and we are still not in the battlefield yet. And that is a pretty successful robot. We are still a ways away from Atlas being capable as an alpha dog. Maybe 10 years.

Q: Most people I talk to are looking at robots to be servants. They want a robot to go get them a beer.

A: Right.

Q: Do you think servant robots are 10 years away?

A: Probably about 10 years, but they won't be affordable. Maybe you would be at a few hundred thousand for them.

Q: I suppose that if you could program a robot to get a beer, you could certainly program a robot to kill, and there's your Terminator robot.

A: Yeah, we don't talk about the defense applications of the DRC. DARPA really wants it to be a humanitarian application. DARPA is the research group of the Department of Defense which keeps us secure, and part of keeping us secure means you need weapons. It's not a far stretch to think that robots will get weaponized eventually. It's still a big challenge as to how you make the decisions about when it pulls the trigger. That would put humanity in a rough spot.

Q: True. Any closing thoughts or comments?

A: Gill (Pratt) did a great job designing the project and leading the program, giving it a good context in having the Department of Defense develop a humanitarian project. He really advanced the field (of robotics).

Interview with Walter Martinez. Walter has been building robots "since he was born." He is a teacher of robotics at Cal State Long Beach, and the Southern California Institute of Technology. He is a BattleBots, Robot Wars, and Robotica competitor, a judge in the LEGO League robotics competitions, and a member and leader in the Robotics Society of Southern California. He has created his own Arduino-based robotics educational kit that is used in several countries, and he provides robots to the entertainment industry for television commercials and TV shows. Walter has been interviewed before by CNN Espanol, Fox News Latino, and many other Latin community news lines. Walter was an invited guest by Robotis to demonstrate the Robotis Bioloid kits that he uses in his classes at CSULB.

Q. What were you expecting at the DRC finals?

A. What I was expecting was to see giant robots moving a little faster and just doing things a little bit faster than you saw on some of the YouTube videos. For this event, they (the robots) needed to be human sized to be able to open a door, (open) a valve, go up stairs, walk through rubble and debris, pick up a cordless drill to cut a hole in the wall, and stuff like that. Because of that, they had to go slowly. But it surprised me seeing how long it took the robot to go from one challenge to another. I'm curious to know what the programmers were thinking when they programmed those robots. I believe some robots were applying artificial intelligence and many of their moves were learned on-the-fly.

Q. So, you are saying the robots were slower than you expected them to be.

A. Yes that's right, slower than I had expected.

Q. Were you disappointed or impressed by the robots competing?

A. I was still impressed because some of them were able to accomplish most of the tasks even when you did not think they were going to, just based on how they positioned themselves. Most were able to grab a drill, cut a hole in the wall, and those kinds of things that were very difficult to do.

Q. Was there any robot that really caught your attention?

A. Yes, the one called RoboSimian. It was an interesting four-legged design. It could walk or roll with its four general-purpose limbs. I really feel this is the future of all disaster recovery robotic platforms. Transforming robots are more complicated, but more stable.

Q. MIT's Robot?

A. No, JPL's robot. Because it did not need to worry about balancing the way the other ones did. Most of the other ones were falling because they would hit the wall or something and lose balance. The four-legged design never fell down. But it had a hard time transforming so that it could reach high enough to perform some of the other challenges. JPL's RoboSimian did very well in the competition.

It was also interesting to see how many teams shared the same platform. Robotis, for example, provided their robot platform Thor-Mang. Many competitors including UCLA's professor, Dennis Hong were using the Robotis' platform, and others Boston Dynamics' Atlas platform. In the world of robotics, there are no standard platforms; it is a very fragmented field. The only thing that is common is the use of bits and bytes. It was interesting to see how some competitors decided to focus on the software instead of the hardware side of things. Many times, hardware and software teams are separate, then they have to figure out how to interface it all. Robotics is such a multidisciplinary field and that is what I love about it. We get to learn so much! Just like Professor Sebastian Thrun (whom I met in the 2007 DARPA Urban Challenge) mentioned that his focus was on software. I also noticed that many of the visiting companies at this event were actually recruiting people for jobs related to software used in computer vision and navigation, so software is big!

Q. Yeah, that's true. Did the robot that you expected to win, take the competition?

A. I was not surprised by the winner, the HUBO robot. (DRC HUBO from Intelligent Systems & Neurobotics Laboratory in KAIST, South Korea). I saw how well it was performing, and I was impressed with it. They also have a huge team of talented individuals, and just like I mentioned earlier, it is a transforming robot with walking and rolling capabilities.

The DARPA unmanned vehicle challenge had a number of people who built BattleBots competing in that challenge. There were many people here in Southern California who entered the competition. I attended the DARPA Urban Challenge in Victorville, CA. It was very impressive to see robot vehicles navigate the streets of an urban area without hitting real traffic, following the rules of the road. It was really interesting to see all the different sensor technology used in this competition.

Q. How do you think these robots that you saw Saturday will affect the future of the military, or the future of mankind? How will they affect you and the world you live in?

A. I think we are a little bit technologically behind. (The competition) definitely provides research results for what is to come. Robots will soon be able to accompany us to events where they will drive and do things for us that we cannot do, and maybe just provide company for humans.

Military-wise, this looks to me like the robots will be able to carry things that humans cannot carry. Of course, get into zones/areas where we cannot get into. They will be used in the areas of the three D's of robotics: dull, dirty, or dangerous; that is where we will see them more and more. This event sets a precedent for what is to come. Based on this current hardware and software, research robots will become faster and more accurate when performing tasks in the future. I still believe that we will see more multi-legged transforming robot platforms down the road.

Q. Interesting. Last question on the DRC itself: Obviously, no one is following Asimov's three laws of robotics, and these days you hear so many people talking about the robots taking our jobs, taking over our planet — our robot overlords, "And so it begins…" What are your thoughts on that?

A. You and I both know that you pull one little wire from a robot and the whole thing doesn't work anymore. There really is no true AI in robotics. True randomness does not exist in computers (unless you use the randomness of nuclear decay in your algorithm). Everything is preprogrammed. Even things that the robots are learning or you THINK they're learning, are all preprogrammed. It's "preprogrammed learning". The idea that they will take over one day, I highly doubt — unless we develop a new kind of brain power such as an organic brain for these machines. The way things are now, they will not take over the world anytime soon.

As for taking our jobs, I always believed that instead of taking our jobs, they will create new jobs with different required skill sets.

People will now need to learn skills such as programming, mechanics, and training in these machines. Perhaps if these machines become so human-like they will require robot doctors, robot psychologists; a whole bunch of other industries could arise because of it. Rather than you digging a giant hole with a shovel, you will have your robot dig the hole, and then your job will be to maintain the robot, and program it. Other jobs will come from this. I truly believe it will benefit us in many different ways, it already has. Look at the da Vinci medical operating robot for example.

Q. Look at the industrial revolution more than 200 years ago. I agree with you. People thought then there would be no jobs, but look at things today, we are approaching an unemployment rate of 5%.

A. Yes, I think it will create more jobs. And now with space exploration, we need these machines to go out there and explore for us before we go. To search for other forms of life, as well.
For surgery, robots are very precise and robot surgery will help us in the future.

Q. Let's talk about the expo that was going on during the competition. What were your first impressions as you walked through the myriad of vendors and robotics engineers at their booths?

A. It was very exciting! I felt like a kid coming through the doors of Disneyland for the first time!

Q. I know what you mean!

A. Even though I had seen a lot of these robots before and know a lot of the people there, I still felt like it was my first time at Disneyland. They even had thematic music that they play at the Indiana Jones ride. You feel like you are in a movie! It was awesome!
I didn't expect to see the props or the ways they had their displays. It was extremely educational and very interesting at the same time. I was fascinated by everything. I read and took pictures of everything. I even took pictures of the posters. One poster was a quote from Henry Ford saying, "If I had asked the people what they wanted, they would have said faster horses. It was fascinating and thought-provoking.
I didn't know they were going to have other pieces to the event such as the expo where you got to see different groups from the universities, makers, and robot companies. I thought it was just the main challenge, but the expo was a great add-on to this. Something to aspire to on the great yearly Riverside Robot Expo.
I didn't expect to see the vendors displaying the latest and greatest of their research, alongside the universities and the maker community from Southern California, but it all makes sense now since many new technologies are sprouting out from the maker community. It is my understanding that DARPA plans to work with the maker community, as well as to do rapid prototyping for simpler projects without having all the red tape that is involved in the bigger projects.
I was surprised to see the great need for people (new employees) who know robotics — especially job opportunities all over the USA. Some companies even looked desperate. They were really, really looking to hire people to do programming, computer vision, navigation, and those kinds of things. It was very encouraging to see that there is a high need for the skill set that a lot of us have in the Robotics Society of Southern California. At least we know we can get a good job in robotics if we wanted to. I felt very encouraged to know this for my students, as well.
I was very surprised to see all the people travelling all the way from the East Coast to demo the research that they are doing. This is fantastic! All the latest and greatest robotics research was right here in one location. They brought all their gadgets that they use. You could actually see what they were using and doing right there live. It was incredible! I got to touch the NASA robots and be part of the Robotis team booth. How many people can do that? Incredible!
I got to see my heroes whom I have not seen since 2009, like Mark Setrakian. He's an amazing artist/engineer. There were some of the best mechatronics engineers in the world. Donald Hutson from Mutant Robotics — a big star in the world of BattleBots — was one of the first who competed in all of the competitions. I got to talk to Trey Roski and Greg Munson — the owners and creators of BattleBots there. We were talking about how the new BattleBots show was airing on ABC. Dean Kamen was in the audience, as well. It was fascinating.

Q. What was your favorite robot at the event?

A. It was Boston Dynamics, Spot — the little four-legged robot. It was so smooth and quiet, and moved like a real animal. It was perfect. And I got to see it about a foot away from me. I asked the guys from Boston Dynamics if I could get a job there. They just smiled back. Everything from Boston Dynamics was awesome!

Q. Anything you want to say before we conclude?

A. Yes, I want to thank Robotis because they sponsored a lot of the groups that were there. They not only exhibited their own products, but invited EVERYONE who uses their stuff to come, including the Robotics Society of Southern California, the Riverside Robotics Society, and your college, the California Institute of Robotics. They fed the presenters and provide good entertainment for the kids. They did a great job. Team Robotis also was a great competitor in the event.

Interview with Karl Castleton on Team Grit from Colorado. Team Grit scored 0 points in the Challenge. They used their own robot, Cog-Burn.

Q: How did you get interested in robotics?

A: I've been doing robotics since the 1980s. I was influenced by *Star Wars*. I started building robots with analog computers. I used operational amplifiers and sensor feedback.

Q: Wow! Analog computers! How and why did you get involved in the DRC?

A: A couple of teammates of mine had been in a number of DARPA challenges. In 2005, I participated in the the DARPA Grand Challenge. We went 21 miles until a throttle servo failed and stopped the car. Also, we qualified in the 2007 DARPA Urban Challenge but did not compete.

Q: What was your part in this challenge? How did you contribute?

A: I was the team lead. Leading this project was a lot like "hurding cats." My job was to get the team the equipment, software, and parts.

Q: Did you do any of the building or programming of the robot?

A: I did the low-level joint control and passive swerve steering.

Q: How did/does your robot or technology stand in comparison with the others?

A: We decided to design a small robot. We designed it to be like a "healthy average woman" of 118 pounds. Imagine if there were a robot that packed up real small and there was a fire. The robot would unpack himself and handle the fire. Fire fighters or police, etc., would tele-operate this robot.
We used less expensive technology. In total, we spent $12,000 in parts.

Q: Wow! $12,000? That is not much compared to the other teams that spent literally milliions of dollars. Did you have any breakthroughs while working on this project?

A: We had a hardware breakthrough. We decided to NOT use standard all-in-one servo solutions. We designed a servo that we could fix instead of replacing a complete servo.

Q: So, you spent a lot of money replacing servos. That sounds like a good idea to make your servo motors fixable. How many hours of effort went into building your robot?

A: We were a volunteer team who worked nights and weekends. We worked on this about six months.

Q: So, that would be about 2,600 hours?

A: About that.

Q: That's not that much. Some teams have been working years. How much money did the team spend from start to finish?

A: Including the dead servos that we had to replace, we only spent about $20,000.

Q: In preparation for the competition, how much time did you personally work on the robot?

A: I worked 20 hours to nearly 40 hours per week as the event came closer. I spent my time writing code and scheduling. Just three weeks before the event ,we designed and built a completely new set of legs.

Q: What is the hardest part about the challenge in general?

A: The reason why I LIKE the DARPA challenges is they are just hard. They are just technically hard.

Q: Yes. I would imagine that they are. But what was the biggest challenge for your team?

A: The hardest part was both climbing the stairs and walking over the rubble. Your robot has to contort itself. A four-legged robot is more stable than a two-legged one, but it is still difficult. A lot of robots got one foot on the first step and then fell.

Q: Why would robots just sit there doing nothing for 3-5 minutes at a time?

A: DARPA was degrading communication and the drivers were waiting for good data to come across the communication link.

Q: What part of the project took the longest time to solve?

A: The hardest part was walking up to things like the valve-mobility — just walking, especially moving across rubble and up the stairs.

Q: What did you think of the other robots in the competition?

A: Usually, I had no idea how the others were doing. I was so focused on what we were doing and what we were going to do next. I was too busy taking care of things like, how to promote the team's skillset.

Q: Was there a robot on another team that impressed you?

A: JPL's robot (RoboSimian) was just a beautiful thing. It's a tight, well thought out design. A beautiful piece of engineering. The wiring is all done beautifully!

Q: If you had to do it all over again, what would you have done differently?

A: I would have given up the redesign of the legs that we had done two months earlier.

Q: What comes next for you and your team?

A: Our mechanical team already has a new set of legs for our robot. I have started an "instructables" on how to build a DARPA robot. We plan to include software, schematics, mechanical designs, etc. We want to completely share it.

Q: Wow! That sounds great! Where do you see robotics going in the next 10 or 20 years? How do you think these robots that competed on Saturday will affect the future of mankind?

A: Until the price comes down, robots will not affect too many people's lives. Robots will still be just assembling cars. They will not be affecting us like cell phones because of the price.

Q: How close are we to truly 100% autonomous "Terminator-like" robots that will "take over the world?"

A: I worry a lot less about a robot revolution when I have my own robot. Having them around, we learn how to react to them. Still, we already have 100% autonomous vehicles. The idea that they are thinking for themselves is not a switch. Cars are more and more being able to protect themselves — like a car's interlock breaks. Eventually, we will have a robot that can think for itself, but we a long way off from a creative robot. It's a lot harder than people think.
On the DARPA Grand Challenge, we tested having a car pull in front of us and cut us off. We wanted to test to see if our car would stop. We had it stop and honk the horn. During the test, it honked once and then honked again and again. It appeared as if the car was mad at the other car. It was the data that "scared" our car again and again (causing it to beep the horn). It acted in a similar fashion to the way a human does.

Q: Any closing thoughts?

A: We really do appreciate DARPA putting out these challenges and allowing the opportunity for non-standard research groups to participate.

Interview with DARPA DRC attendee Maya Marnani from Riverside, CA who is nine years old.

Q: Do you like robots?

A: Yeah.

Q: Do you ever build robots?

A: Yeah.

Q: How many robots have you built in your life?

A: Maybe about six.

Q: Why did you go to the DARPA Robotics Challenge?

A: I thought it would be fun.

Q: What did you like most about it?

A: I really enjoyed the submarine robots because they were robots that went underwater. I also liked being a robot (exhibit). I liked pressing all the buttons, and turning the wheels, and picking up blocks.

Q: What did you think of the big (Atlas) robots walking on the treadmills?

A: They were cool and I liked them very much.

Q: Were there any robots that scared you?

A: No, not really.

Q: Were there any robots that you thought were awesome?

A: I thought the 3D printed parrot robot was really cool.

Q: The parrot robot that bit my finger?

A: Yeah!

Q: Was there anything that you did not like?

A: I think I liked everything.

Q: Do you think someday you will become a robotics engineer and build robots as a job?

A: Maybe.

Q: Was there anything else that made you happy that day?

A: Actually, there was the Meccanoid robot. The Meccanoid robot is a rolling robot, and it can listen to commands. Its eyes light up. I got to build it.

Q: Fun!

Q: If you could describe your day at the DARPA Robotics Challenge in one word, what would it be?

A: Exciting!

Q: Thank you, Maya.

A: You're welcome, Daddy.