Indiana University, Indiana

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Lynne Parker

An interview conducted by Peter Asaro

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Early Life

Interviewer:

You could just start by telling us your name and where you were born, and grew up, and went to school.

Lynne Parker:

Okay. So, my name is Lynne Parker. I'm from the University of Tennessee. And I'm originally from Tennessee. So, I'm in my hometown. Except now that I'm on loan to the National Science Foundation. So, I'm in both places. But I'm an original Knoxvillian, and went to school-- got my bachelor's degree at Tennessee Tech University in Cookeville, Tennessee, my master's degree at the University of Tennessee in Knoxville, and my PhD at MIT.

Interviewer:

What did you study as an undergraduate?

Lynne Parker:

Computer science. All of my degrees are in computer science. And my graduate degrees, of course, are more focused in artificial intelligence and robotics.

Interviewer:

How did you first get interested in computer science and artificial intelligence?

Lynne Parker:

So, it's a little bit of sibling rivalry. I have a sister that's a year older than me. And she was going to study engineering. And so, I had to study something different from engineering. But I loved math and science. And so, my father had the course catalog for the school that I was going to, which is the same school as my sister was going to. And he said, "Well, look. Here's computer science. They have math and science. Why don't you study that?" And I said, "Okay." So, I became a computer scientist. But it was really a perfect fit for me.

ORNL

Interviewer:

Artificial intelligence preceded the interest in robots?

Lynne Parker:

It did. So, my first exposure to artificial intelligence and robotics was when I was doing my master's degree at University of Tennessee. So, I was working in Oak Ridge full time and then doing my master's at night. And one of the classes that I had at night was taught by the fellow that led a robotics lab at the Oak Ridge National Lab. And it was an artificial intelligence class. But it included a lot of robotics. And so, that was one of the classes I was taking for my master's degree. And that was really my first exposure to AI and robotics. But I just loved it. And so, after the class was over, I went to the instructor and said, "If you ever have any openings in your robotics lab at ORNL, I'd love to come work there." And so, he offered me a position about six months later. And so, that was my first opportunity. So, that was at Oak Ridge National Lab, my first opportunity.

Interviewer:

And who was that?

Lynne Parker:

That was Chuck Weismann. And so, he was the head of the robotics lab. It was actually called CESAR, Center for Engineering Systems Advanced Research. He went on later to Jet Propulsion Lab and was an advocate there for robotics for many years.

Interviewer:

And what was the first kind of robot that you worked on there?

Lynne Parker:

Well, the first robots that I worked on-- at CESAR, we had a series of robots called HERMES. And that stands for some-- it's an acronym for something that I've long since forgotten, H-E-R-M-E-S. But those were robots. At the time, this was in the '80s. Those were some of the leading robots in the world. Really, that research lab, robotics research lab, at ORNL was of the most advanced at the time. So, these were all homegrown robots, mobile robots, indoor mobile robots, but they had lots of sensors on them that are very common on today's robots as well. So, those were the robots, the HERMES series of robots at ORNL.

Interviewer:

And do you remember the project that you worked on with them?

Lynne Parker:

Sure. So, the first project I worked on was a project called Human-robot Symbiosis. And this was a project that the goals are even current today. It was a very tough robotics challenge. So, the objective is to try to get to work together like a symbiotic team. And back in those days, ORNL did a lot of work with manipulator robots like for remote handling of hazardous material. And so, they had manipulator robots that could be tele-operated by a human but also controlled directly by a robot, I mean autonomously. So, the idea of this human-robot symbiosis project was to see if you could have the robot watch the human as he or she performed some sort of remote manipulation task and then learn those tasks and then be able to automate those and take over some of the more difficult challenges. You still see a lot of research today that's trying to do that. The particular part of the project that I worked on was called task allocation, trying to decide when the robot should do its task or what task should be assigned to the robot, and then which ones were too hard for the robot and should be done by the human. So, that was really my first foray into robotics was in the task allocation area. And then I continued to work on task allocation for many years after that.

Interviewer:

Did that develop into your master's thesis?

Lynne Parker:

You know, no it didn't. I was a glutton for punishment. So, I did a completely different topic for my master's thesis, which was the navigation of robots through multiple moving targets. So, it was all done in simulation. But it's the idea of how do you get a robot to plan a path in 2D through a space where there are lots of objects moving here and there and so forth through the environment. So, that was my master's thesis was an algorithm for robot navigation and multiple moving targets. So, it was completely different from what I was doing at work.

Interviewer:

And who did you work with for your master's degree?

Lynne Parker:

For my master's degree-- oh, now this is the part that you're going to have to edit out because it's been so long since I've thought of this. He was not-- I really did my work on my own. It was-- so, don't include this in the interview. I couldn't even-- I'm embarrassed to say I can't think of his name. He was just a person on paper you know?

Interviewer:

That's fine. And then you went to-- did you keep working at Oak Ridge, or did you go to—

Lynne Parker:

I did for a few years. I continued to work at ORNL. But I was the only person that only had a master's degree. Everyone else had a PhD. And that was really my first exposure to research. And I learned very quickly that you

need a PhD if you're going to have a career in research. And I just loved the work that I was doing. But because I had done my master's degree at night while working full time, I said there's no way that I'm going to do a PhD at night while I'm working full time. So, I decided if I'm going to take a leave of absence from ORNL, I'm just going to apply to the best schools and see who takes me. And then I'll take a leave of absence. So, I was fortunate enough MIT accepted me. And so, I took a leave of absence from ORNL in order to go do my PhD. And that was about-- that was a couple years after I finished my master's degree.

Interviewer:

What year was that?

Lynne Parker:

That was-- so, I went to MIT in '89.

The Multirobot Collaboration Project

Interviewer:

And who did you start working with?

Lynne Parker:

So, Rodney Brooks is my PhD advisor. And I was very interested in multirobot collaboration. At ORNL, we had multiple robots. And at the time, there were just very few robotics labs that even had multiple physical robots. And so, that was a topic that I knew I was very interested in. And so, I proposed that in my statement to graduate school. And it turns out that he was also very interested in that. Of course, they had lots of robots in the AI lab. And so, he agreed to let me come to his group and do research with him. So, he was my PhD advisor.

Interviewer:

And what was the project that you initiated there?

Lynne Parker:

Well so, that was also a task allocation problem. It was a task allocation problem for heterogeneous multi-robot systems. And that's been a theme of a lot of my research over the years is having the ability to coordinate and collaborate between robots that are not identical. So, rather than having swarms of robots where they can all run the same algorithm, now you have robots with different skills and capabilities. And what you want to do is to be able to figure out who does what based on a good match of skill and need for the task and so forth. And so, that's really been a theme for my research is different kinds of robots working together. And so, that's what I addressed in my PhD dissertation. I developed a system that's called Alliance. And Alliance, the main idea in Alliance is to try to eliminate the need for explicit communication between robots. If you look at the state of the field prior to my dissertation as it dealt with heterogeneous robots, most of the work required robots to negotiate with each other. And so, they would have a conversation about I could do this at this cost. And a robot would maybe bid on a different task at a different cost. And they'd come to some consensus as to who would do what. But this would all take place through active communication. And I was really interested in robust systems that would work even if communication failed. And so, my system then for dynamic task allocation allowed robots to observe what other robots were doing and then implicitly make decisions by building up models of what other robots are capable of in order to decide individually what task that robot should do. And so, all the robots then are observing not only the actions of other robots, but the current state of the environment and the needs of the task in order to decide individually what each robot should do. So, the main mechanism for achieving that was through what I called motivations, motivations of impatience and acquiescence where a robot would be impatient for a particular task to be accomplished and then over time its motivation would grow until it crossed a threshold. At which point, it would take over a task. Acquiescence is when a robot is already performing a task, but it's monitoring its effect through the world. And if it determines that the task is not being accomplished properly, it may be willing to give up that task to another robot that says, "Hey, I'm impatient to do this task." And so, the first robot then will acquiesce. And so, this was the gist of the Alliance architecture for task allocation. Task allocation has been studied by many people over the years since. And if you look at the performance improvements of the system using Alliance, it has been shown to

still be competitive and even superior to some of the more recent task allocation techniques because of the ability to model other robots.

Interviewer:

Interesting. And what did you do after you completed your dissertation?

Lynne Parker:

Well, I went back to Oak Ridge National Lab because I still had a job there. I was on educational leave of absence. And I really-- again, it was a top robotics lab and doing really basic research in robotics, mobile robotics, the kind of robotics that I was very interested in. So, I went back to Oak Ridge National Lab and worked there. That was in 1994. And I worked there until 2002. But I got the itch to get into academia. We have the opportunity to work with a lot of students at ORNL. But the students would be there for a semester or a few weeks, and then they'd go. And I enjoy teaching also. And so, I was able to move to the University of Tennessee just still in the same town, and have an academic position where I could continue the same research, but then also be able to work with students. And so, that's what I did.

Interviewer:

And before you were at UT, were there other roboticists working there?

Lynne Parker:

At UT?

Interviewer:

Yeah.

Lynne Parker:

Well, the main person that I was most familiar with was Bill Hamel. Bill Hamel had previously also worked at Oak Ridge National Lab. In fact, he was my first boss in the CESAR-- actually he was not in CESAR directly. But he was in another group at ORNL that also did robotics. And so, he had worked at ORNL for years and years. And then he also decided to move to the university. He was in a different department, mechanical engineering. And I'm a computer scientist, so I moved to computer science department. But he was the main roboticist at UT at the time.

Interviewer:

And has UT provided an opportunity for collaboration between departments around robotics? We find that it winds up in different places.

Lynne Parker:

It does. And our university is the same. We-- obviously through research proposals, funding sources, we collaborate on projects. And certainly Robotics and Automation Society has provided a lot of opportunities for us to collaborate on conference organization and that sort of thing. I was the editor and chief of the conference editorial board when Bill Hamel was the program chair for ICRA 2014 in Hong Kong. So, we've worked together professionally in that capacity. In terms of research, I hate to say that we have not been successful in getting collaborative funding. But certainly, you know that's just how the ball drops some times.

Interviewer:

And there's no particular sort of major for robotics? Students come in either as ME or computer science.

Lynne Parker:

No, that's right. We don't have a major in robotics or a particular specialty in robotics. Although, we do have a lot of classes in robotics. So, if students are interested in that area, then they certainly have plenty of classes that are relevant. And in computer science we have a center that's called CISML, Center for Intelligent Systems and Machine Learning. And that center is a cross-disciplinary center that focuses on machine learning. But there are a lot of overlaps into robotics. So, several of the newer roboticists that have joined UT, say from mechanical engineering,

are part of the center. But in addition, we have mathematicians. We have people from psychology. We have people from the business school interested in business analytics. We have a lot of people from Oak Ridge National Lab who are interested in big data and machine learning applied to big data as well as cybersecurity. So, there's an overlap there. We use a lot of machine learning in our robotics work. But some of the techniques that we use for our robotics research that take advantage of machine learning algorithms are also relevant for these other topical application areas. So, we have a large center that includes a lot of these topic areas. So, the classes that we teach are focused on machine learning, but they have direct relevance to robotics.

ICRA and the NSF

Interviewer:

So, you mentioned ICRA. Maybe you can talk a little bit about the history of your relationship with the IEEE and the organizations around robotics.

Lynne Parker:

Well, I became a member of Robotics and Automation Society back when I was a PhD student, I believe. And so, over time, you begin to get involved in program committees and various activities like that. I started getting involved in some of the conference organizations and in the editorial activities, first with the transactions on robotics. So, I was invited to be an associate editor many years ago. And then I became an editor. And then the timing was right for-- they had a need for a new editor in chief of the conference editorial board, which is the main review board for the flagship conference for RAS, the ICRA conference. So, that was a few years ago. It's a three-year appointment. So, I became editor in chief of the conference editorial board for a few years. And so, that of course was-- I think it was for ICRA 2012-- no, 13-14-- 12, 13, 14, ICRA 2012, 13, 14. And so, then you begin to get tagged for other organizational activities. So, I was a program chair for IRIS this past year in Chicago. And then of course, I'm general chair for the ICRA that's coming up in Seattle this May with Nancy Amato as the program chair. And then in addition with the Robotics and Automation Society, in the middle of that, the nominations committee invited me to run for the administrative committee, ad com, of Robotics and Automation Society. So, I did. This was about seven years ago. And so, I served in two consecutive terms for ad com, about six years, for the administrative committee of Robotics and Automaton Society. So, after two consecutive terms, you get a free vacation for two years. And so, I'm off that ad com now.

Interviewer:

Great, and you've also been doing service with the National Science Foundation as well.

Lynne Parker:

Right, so I started at the beginning of January as a division director for information and intelligence systems at NSF, which is in the CISE directorate, that's computer and information science and engineering directorate. So, that directorate covers all of computer science, NSF funding for all of computer science. A statistic that I didn't know is that eighty-seven percent of the basic research in computer science in the U.S. is funded by the National Science Foundation, which is a much higher percentage than for other areas of science and engineering. So, it's a very important funding organization for computer science in this country. So, that CISE directorate consists of four divisions. And so, I'm the head of one of those divisions, the IIS. And the Information and Intelligence Systems division oversees research in several areas. It includes the National Robotics Initiative. It includes the Big Data Initiative. We have some core programs such as Robust Intelligence that includes a lot of machine vision and robotics and natural language processing and these sort of what I would call core areas of artificial intelligence. It also includes informatics, so some databases, new models for databases and that sort of thing. It also includes a core program in cyber-human systems, which involves a lot of human-robot and human-computer interaction, any kind of cyber-system interaction. We also oversee some things like collaborative research for computational neuroscience. So, there's a whole portfolio of programs in this vein. I would give it the high level of sort of AI, which includes-- and also informatics. Machine learning through big data is a big component of what we oversee. A lot of these are collaborative, of course, with other divisions and agencies within NSF and outside NSF. But that's the main mission of IIS is to oversee the funding for those research areas.

Interviewer:

How is that tied into the White House's kind of robots initiative?

Lynne Parker:

It's the same initiative. So, the way that these new initiatives come to be is that there's a discussion, a conversation between what the administration is interested in and then of course what the research community through NSF is interested in. And so, certainly the Office of Science and Technology Policy, OSTP, which is the White House's advisory council or committee or organization that looks at science and technology nationwide, worked very closely with many members of our society, the Robotics and Automation Society, to develop a roadmap and a mission for robotics in the country. And so, that was a close collaboration—

<break in audio>

Interviewer:

The Office of Science and Technology Policy.

Lynne Parker:

Right. So, the Office of Science and Technology Policy worked very closely with NSF and other agencies in order to stand up the national robotics initiative. And it's really from the OSTP perspective, it's part of the broader manufacturing initiative. And so, the idea is to bring back to the U.S. manufacturing, particularly of some small scale kind of manufacturing or sort of one-of manufacturing, which is the type of manufacturing that's not typically easy or efficient to do in the U.S. Usually, large-scale manufacturing is much more efficient. But through robotics and through new technologies for being able to quickly program new systems and have them smart enough to figure out new production runs and this kind of thing, a lot of human-robot interaction. And so, that is sort of the bigger umbrella under which the national robotics initiative sits. But as you know, the National Robotics Initiative really has a theme of co-robots. And so, it's robots that work with people in a wide variety of contexts. So, it can be manufacturing. It could be in society, maybe firefighters. It could be in the work place, robots that work in the office. It could be robots that work in eldercare facilities. So, really the whole theme of the NRI is having robots to work with people to improve societal needs. And it can be across any area of society that you can imagine. So, this is really the development of the National Robotics Initiative was really a collaboration between OSTP and NSF and other organizations, but NSF was certainly the lead.

The Distributed Intelligence Lab

Interviewer:

As you see it, what are the biggest challenges facing these kind of human-robot interactions and symbiosis?

Lynne Parker:

Well, from a technical perspective, to me the hardest challenge is for a robot to really understand what the human intent is and what the human motivation is and their goals and objectives and to really understand the current state of what the human is thinking and doing and the state of the environment. Robots can react and can plan based on very specific inputs and sensory feedback. But being able to understand the bigger picture of what is the context of how the human is working and being able to deal with unexpected changes to that context is the real tough problem in all of robotics, really. But with a human in the loop, it makes it even more challenging because we don't have good models of a human, nor do we necessarily want to have a perfect model of a human because it's very difficult to imagine that we could take into account all the possible mindsets of people and the emotional state of people and all the common sense kinds of things that would feed into how a human make their everyday decisions. So, the question is how do you have a robot then that is helpful and useful in light of a lot of uncertainty. And to me, that's the biggest challenge of all of robotics including working with people.

Interviewer:

And what are some of the projects you've been working on since you go to UT?

Lynne Parker:

So, my research-- I have a laboratory that I call the Distributed Intelligence Lab. And it continues the theme of having teams of robots and agents and sensors work together. And so, we have projects that deal with more complex issues of action selection and task allocation issues. Again, a machine learning, threading their way through these different activities so that you can have robots and systems of sensors that can learn what the current context is, learn about what the other entities are in the system, even learn about people in the environment, and then adapt how they behave over time. We've looked a lot at robustness in these systems. What if an entity like a robot or a sensor or set of sensors fail? How do you have the system be able to detect that, to understand what kind of failure there was, and then to be able to compensate for that, or even to be able to anticipate that it's coming and take some action in order to avoid some sort of failure? So, that's really sort of prognostics to improve reliability and robustness. That's been a common theme. And then in recent years, we've been looking more at humans in the loop, so teams that involve both humans and robots. And our focus has been what we call peer to peer human-robot interaction. And we want to have robots that can pitch in to be helpful in teams that include humans without the humans having to directly command and control the robots or to tell the robots exactly what to do. we want the robots to be intelligent enough to figure out how to be helpful in the current context. So, this is what we call peer to peer. We want the robot to act just as if it's another teammate. And you want it to be helpful. But a real challenge in that comes back to how do you implicitly understand the current context of what the humans are doing. So that's been a real focus in recent years of being able to use perception to observe and understand human activity and then to be able to have the robot or robots pitch in in a manner that's helpful to contribute to the overall objective and task of what the human is doing without being intrusive. And so that's really been our focus is how can you have implicit cooperation between humans and robots and really push the boundary of that. So for instance, we don't look at things like how does a human talk in a natural language to a robot. We're really pushing the envelope of saying what can you do in the absence of that direct communication. It was really this research theme was inspired by some work that we did with Lockheed Martin several years ago and they were looking at military applications of having robots that could do things like serve as the point robot for clearing a building as an example. So it's very dangerous to be the first person through the door, but what if the robot is the first agent through the door and then it could look to see if there's danger or it could even draw fire, but you don't want to have a soldier or a Marine to have to pay attention to that robot in order to guide the robot through the building. You want the robot to say okay, we know how to clear a building. These are the tactics, techniques, and procedures that we use, and so the robot goes off together with the team to do its part in that task and so it's really to relieve the human of the need to pay attention to the robot because in these situations it's too dangerous for the soldier or the Marine to have to be focusing on the robot. They need to be focusing on the mission and their environment and so that's where it was really inspired, but our work is not really a military application. It's really more broad in the sense of in any social context, how can a robot be a peer partner with human teammates?

Interviewer:

So what are some of the other robots and applications that you've used this research for?

Lynne Parker:

Well, the current robot that we're using is a robot that was developed by a spinoff company going back to one of Rodney Brooks' students. Aaron Edsinger started a company called Meka Robotics which has now been acquired by Google and so we call it the Meka robot. It's a robot that has compliant arms and that was the main technical expertise of the Meka company was in the compliant manipulator arms series elastic actuators, but they constructed a robot for us that has two of these seven degree of freedom arms plus hands, a smart sensor head that allows you to detect. It has something like a Kinect on there. It has lots of cameras on it so you can have very accurate perception of what humans are doing in the environment and the head and the arms are on a Z lift so you can get up to different heights for different kinds of tasks and the whole platform is on an omnidirectional base. So it doesn't have legs, but it moves around on the ground and so it can move in a space that is human scale and it can manipulate doing tasks that are humanlike and so this is our peer teammate that we're working on with our human robot interaction because it can do human scale tasks. So that's the more sophisticated robot that we have for this peer-to-peer collaboration. Some of the other robots that we've worked on include the NAO robots and we have a lot of the Active Media Pioneer robots as well. And then we have little small robots that we've used for educational purposes, little scribbler robots that were adapted by the Georgia Tech Institute for Personal Robots in Education. We've got over 100 of these that we use for educational purposes, but we also do some swarm robotics research with these robots. So that's kind of the gamut of the robots we've used in recent years.

Applications for Research

Interviewer:

What are some of the applications, tasks that you're trying to work on the teamwork with?

Lynne Parker:

Well, we look at tasks. Of course we're a basic research lab and so we do things in the laboratory. In terms of the peer-to-peer interaction, we're looking at tasks such as maybe have a bunch of objects that need to be sorted and placed on shelves in some sort of order, so having robots to be able to perhaps help with maybe alphabetizing a stack of books and putting them on the shelf like you're trying to put new books into a store or a library or something like that. Another aspect of the human-robot interaction that I haven't mentioned is our work to have the robot be a teacher to a human with learning disabilities and so we're in the middle. I have a student that's in the middle of human subject studies. To have the robot be able to teach young people that have learning disabilities a variety of tasks. These are tasks that have occupational application such as making change and so we have a protocol where the robot observes how the human is doing a task like making change and then gives a system of prompts to the human, after understanding that maybe the human is stuck, the student is stuck or is making an error, and so the robot continues to prompt. First just small prompts and then a little bit more information in the prompts to help the students be able to learn a new life skill. And so that's one of the areas that we're looking at is how do you teach people with learning disabilities new life skills so that then they can be more independent and on their own. So this is an application area that we're looking at, making change. There's also in that domain a lot of small assembly kinds of skills are helpful for these students because they can get jobs in say some light manufacturing if they can assemble parts together and so you may be familiar with a tangram puzzle where you have all these little pieces and you need to fit them together to form a bigger shape, like a duck, and so teaching again the students how to think about these puzzles and how to assemble these pieces together into a broader form or figure is teaching them assembly skills. So this is a whole area that we're working on, particularly physical tasks that require operations in a physical world, a thrust area of our research. In the broader human-robot interaction, sort of the peer-to-peer teaming, we're looking at a lot of office skills, how you could have a robot that works in an office environment and then also security and surveillance kinds of tasks where you may need to search for some objects in a building as a large team. You may have some humans on the team that are leading the way and then the robots need to pitch in and contribute to the search task according to how the human is displaying their approach to the search problem. So these are sort of the range of tasks that we look at.

Interviewer:

And who are some of the graduate students that you've worked with who have gone on to work in robotics?

Lynne Parker:

Okay, well, I have also had some post-docs that when I worked at Oakridge National Lab that are continuing in the robotics area. Yi Guo is one. She's an associate professor at Stevens Institute of Technology and she's working on also a multirobot system and her most recent work has to do with having multiple underwater robots that can track plumes, like chemical plumes as in the Deep Water Horizon oil spill. Raj Madhavan was another post-doc that worked with me, or he's actually a graduate student that worked with me when I was at Oakridge National Lab. He's been active in the Robotics and Automation Society in the industrial activities. I think he's currently vice president of industrial activities in Robotics and Automation Society. He also works with the SIGHT initiative in Africa or maybe it's just the developing world, of looking at humanitarian applications. I think it's called SIGHT. Humanitarian applications of robotics. So he's been very active in the society. He worked at NIST for many years and looked at standards for robotics and then also he's affiliated with the University of Maryland. Another student that I had that visited while I was at Oakridge National Lab was Stefano Carpin. He's a professor at University of California Merced and he looks at a lot of planning problems that have to do with multi-robot systems. I have a PhD student, Daisy Tang, who's at the University of California Pomona or California State University at Pomona and she looks at robots for education and also some multi-robot systems kind of work. I have another student Balajee Kannan who was at Carnegie Mellon for a while as a research staff person. He's now at GE Global Research and they're working on a project for the Veterans Affairs, VA, that has to do with cleaning medical supplies prior to operations, I think, and so they have Baxters and several other robots that they're working on there. I have a student Hao Zhang who's now an assistance professor at Colorado School of Mines and he did a lot of work with me on the

intent, understanding the human activity recognition that applies to this peer-to-peer human-robot teaming and so those are some of the students and other colleagues that I've worked with in recent years.

Collaborators

Interviewer:

Who are some of the other faculty that you've collaborated with or labs? Have you gone to do visiting?

Lynne Parker:

I have not done any visiting appointments. Some of the people that we had a DARPA project several years ago that was with the University of Southern California. So Gaurav Sukhatme and Andrew Howard were the main collaborators that we worked with on that project many years ago. So there have been collaborations. A lot of the collaborations that we've looked at that we've done are a little bit more in the terms of conference organization and that kind of thing. I tend to be a little bit more of I want to do my research my way and so I tend to have a lot of single investigator research grants that allow me to develop my research in the way that I see fit. So I don't have a lot of research collaborations in that regard.

Interviewer:

And where have you gotten research funding?

Lynne Parker:

Well, my research funding comes from the National Science Foundation. Because Oakridge National Laboratory is so close and convenient, some research collaborations there and research grants I've gotten in the past, some DARPA grants, and those have been the main sponsors.

Women in STEM and robotics

Interviewer:

Great. Being one of the women who's really sort of organizing and overseeing, how have you seen the movement of women into sort of leadership positions within robotics both at the NSF and the IEEE? Sort of over the course of your career, have you seen more women moving into it? Has it been challenging?

Lynne Parker:

Well, in terms of the Robotics and Automation Society and just the research field in general, it's been very slow. There are some senior women obviously in the field, but the increase in numbers of women has been almost nonexistent and I don't know all the reasons for that. I think there are some difficulties in having visibility for some of the newer women that are entering the field. There are certainly some areas where the women are entering the field in larger numbers such as biomedical applications of robotics, but in general it seems slow and that's one of the reasons why for this ICRA conference, the 2015 conference, it was really George Lee's idea, professor at Purdue, to have an all-female organizing committee and our objective in that is really to raise the visibility of more women in the field because there are a lot of women that are doing a lot of good research, but organizing committees for conferences don't typically think of them when they're getting ready to put together an organizing committee and typically they have one or two women on the organizing committee and sometimes it's the same small group of women over and over, but there are more women that could contribute, and I've had conversations with organizers and they just don't seem to be familiar with the other women in the field. So part of our motivation for putting together this all-female organizing committee for ICRA 2015 is to raise the visibility of some of these women that are there, but people are just not recognizing that they're there, and it's also to provide some role models for some of the more junior women so that they can see, they can learn about other women. They can maybe talk to them in a mentoring capacity, talk to them about lessons learned or suggestions about their career paths. So I think that's really our objective for having this all-female organizing committee is to really sort of try to plot the path here for having more women in leadership positions in the society. NSF has actually done an amazing job in my experience in including women and many of the leadership positions at NSF are held by women and so I think as an

organization, they're really leading the way. They're sort of practicing what they preach and trying to include women in the leadership positions. And so they've actually done a much better job than the field as a whole, in my opinion, in including women. And so I think it's a complicated issue. I think in the US, the US is leading the game when it comes to trying to have as many women involved as possible. Europe is working hard. I know a lot of their programs, they have to address the issue of diversity as it relates to women. Asia's more difficult. I think there are cultural reasons why it's more difficult for women to advance in their professional fields. But in any case, I think we have a long road to go. My own personal opinion is that when it comes to universities and industry and including more women, I know a lot of people like to talk about the pipeline being thin or small, whatever the word is, so there are not enough women entering the field, and that's certainly true, but it's also true that a lot of women leave the field, and to me we really need to address this issue of why women are leaving the field and I think a lot of it is internal to organizations. They maybe don't always recognize the climate that's being created that maybe has very subtle reasons why women are not comfortable or they don't feel included once they're in industry or academia. So I think there are a lot of reasons why women are not increasing in numbers at a very fast rate. I think there's a lot of work to do by the whole community.

Interviewer:

I thought it was going to take like five minutes to . Have you seen any differences with women in robotics versus women in computer science or artificial intelligence or is there something about the field itself or do you think it's more institutional?

Lynne Parker:

It's a good question. I think there is a stereotype, but I think there's some truth in it that women are attracted to fields where it seems more like you're helping people as opposed to sort of you're sitting in your office and you're doing something that seems somewhat esoteric. Part of that is just in my opinion a marketing issue because we're not properly conveying to women how different areas of computer science or engineering actually are helping society and maybe it seems like it's not directly helping people because you maybe don't work with the end user on a daily basis. But in any case, I think these are some common issues across computer science and engineering and robotics. Now it could very well be that because robotics has a much more direct link to the end user that women in theory would be more attracted to the field and we certainly see a lot of women in the field. I don't know the numbers, but I would not be surprised if there are more women in robotics than there are in computer science in the broad sense just because you have that closer connection to the end user and it feels more like you're helping someone directly when you have a tool that you're building that you can directly demonstrate for them as opposed to writing some compiler that people use and it helps them, but you never meet anybody that loves your compiler. So this is my own feeling is that there is a more tangible and direct link to the end user that's appealing to women in the robotics field, but I don't really have numbers to back that up.

Interviewer:

So another question we usually wind up with is what's your advice for young people who might be interested in a career in robotics?

Lynne Parker:

Well, my advice would be first to go for it, to certainly go with your passion and with your dreams. I think in robotics there is a real need for interdisciplinary and multidisciplinary understanding and so I would certainly encourage young people to learn about a variety of different areas that maybe aren't exactly their major, but can really contribute to robotics. So a computer scientist, for instance, knows how to program, but you also have to learn about hardware in order to write software that can control the hardware. So to some extent you have to go somewhat into the engineering areas in order to understand the hardware enough to write the software. Or if you're using robots to interact with people, then you need to understand more of the social side of things or maybe the educational side of things so that you can see how best to develop a robot that can apply to some social setting or an educational setting. So really I think it's important for roboticists to broaden their horizons and to learn about technologies in a variety of areas. Certainly there's computer science, there's mechanical engineering, there's electrical engineering. There's cognitive science, there's mathematics, there's social science, there's psychology, there's neuroscience, and all of these areas have information that is important to a roboticist. So I think for me the most important thing is to be willing to delve into all of these areas. You don't have to be an expert in all of these

areas. Nobody can be, but being able to understand what the issues are and what the main state of the art is and how these technologies and sciences contribute to robotics I think is really important to be a successful roboticist.

Interviewer:

Great. Is there anything we didn't cover that you'd like to talk about?

Lynne Parker:

I'm sure there's something, but nothing that comes to mind.

HRI and Robotics

Interviewer:

Well, maybe we could talk a little bit about HRI. You might have any questions about HRI. It is evolving as a field sort of alongside robotics. So have you seen that sort of emerge as a standalone field?

Lynne Parker:

I think so. I think to some extent you have to make enough progress with an individual robot by itself, an autonomous robot, until you can make it intelligent enough that it can begin working with humans. And so I think over the years individual robots have become sophisticated enough that now you can be confident that you can put them in the same workspace with a human and it will be doing something beneficial and helpful and appropriate in that domain. Certainly many years ago it was too dangerous to put a robot and a human in close proximity to each other and so I think the hardware has improved in the sense that you have compliant systems that are safe for humans to be around, but then the intelligence of the robot has improved enough that they can have enough ability to understand what it is that they should be doing with the human. So I think because of the advances in individual autonomous robots getting to the point where they're sophisticated enough, we now have the ability to work with humans and so that then because of the obvious societal need, that then has really escalated in the last many years. So I think you had to start with enough advances in the individual autonomous robot, and that's been accomplished in some sort of focused areas, and so now we can start putting humans in the system. So I think in this country because of how the national robotics initiative was formulated to very specifically focus on co-robots to some extent the funding drives the research and so that has certainly helped escalate it and the European Union has done the same thing. They have robots in systems with humans and Japan started off early on in their humanoid robotics research in trying to develop systems that could help elderly people as they're aging. So I think in some sense the funding has driven it, but the applications, the important applications are also driving it. So now that robots are sophisticated enough to do something useful, we're seeing a growing interest in the human-robot aspect of the research.

Interviewer:

Do you have any insight into how the decision was made to make it very co-robotics oriented? So really putting the kind of connection to the human front and center in the program?

Lynne Parker:

So I was not involved in those earlier developments, formulation of the program. People like Vijay Kumar and others can get a little bit more of the background, but my suspicion is that there is some concern, of course, about pure autonomy not really achieving the type of performance that you want because it's really hard to have a system that can act completely on its own and be exactly right and deal with such a dynamic world and dynamic systems, and so I think part of the acknowledgement is that we know we're not going to get to the point of pure autonomous systems, so why not look at what's more practical in the next decade which is having humans and robots that can work together. I think there's probably also some political aspect to this in the sense that if you only build autonomous robots that work on their own, there's a sense of their replacing humans and humans are somehow going to be superfluous and what does that mean for society and why is that a good thing? And so I think because it's maybe not the goal that we want, we really want robots to improve society, not just replace people. So I think that also was a motivation in having the sort of co aspect of robots. Robots really being helpful to people, not people being subservient or replaced by robots.

Interviewer:

Do you have a feeling for what are the particular application areas that the people here feel are more important? Like you mentioned in Japan, there's this big focus on elderly for different societal reasons, their population, and the desire not to have too much immigrant labor. Do you have a feel for what are some of the applications that are more important for the US context?

Lynne Parker:

Well, my sense, and just from what I know of the funding for the national robotics initiative, as far as the National Science Foundation is concerned, we don't really drive the application. We want to drive the science and it's really all about good science. So it's really up to the investigators to make a case as to how their ideas are going to improve society. So NSF and in terms of its funding does not make a preference of one application area over another. Now of course NRI is not just an NSF activity or initiative. There are also collaborations with National Institute of Health and DARPA is a new player, Department of Agriculture and so forth, and so those of course, those agencies obviously have their own applications that drive the research and so and NASA. I didn't mention NASA, and so if there's a space application that an investigator wants to pursue and it's something that say NASA is interested in, then clearly those applications would be funded by those organizations and so if it's pure science that crosses multiple applications, that would be what NSF would be interested in. So I think in terms of a broad brush, the individual organizations that have focused missions like Department of Energy is another one that may be interested perhaps in the future in joining the NRI. They would have their own application areas, but in terms of basic science, there's no preference of one or the other application topic.

Interviewer:

Thank you. Thank you very much.

Lynne Parker:

Okay, absolutely.