Interviewer: Today on the future of everything, the future of AI and air traffic control. First of all, I want to say that we’re still taping under zoom conditions. So I apologize for any technical glitches or we’re doing our best and we hope you’re all safe. Back to AI and air, there’s a lot of talk about autonomous systems for transportation. There’s driving cars, self driving airplanes, and helicopters, self driving boats, self driving spaceships. Each of these is an active area of research with critical considerations, I think, obviously of safety and economy. Can we get people in cargo to where they’re supposed to go safely and efficiently. They can have many challenges in order to be tustworthy and to be trusted by those tho use them. AI algorithms, machine learning algorithms show great promise in being able to assess the environment and make rapid conditions to control a vehicle. But of course, there’s always worry about whether AI will make good decisions in difficult circumstances, especially rare circumstances that the designers may not have anticipated or made it as literally never happened before, situations in which, of course, even humans can find themselves and which can be very difficult. Humans use their experience and judgement to make the best decisions, hopefully with good outcomes, but not always. How will AI systems make these decisions? And how will they stand up to the scrutiny if and when things go wrong? Professor Mykel Kochenderfer is a professor of aeronautics and astronautics as well as computer science at Stanford University. He is an expert at building autonomous systems and in particular systems for aviation. Mykel, what are the main challenges as you see it for trustworthy, autonomous vehicles?

Interviewee: So I see there being two major challenges, the first one is how do you build them in the first place. There are a number of challenges associated with that. And then a second major aspect is how do you then go about validating the systems.

Interviewer: Yeah

Interviewee: So Going to the first part, how do you build these systems to be safe. It’s actually really, really tough. And I don’t think the general public appreciates how hard this is. It’s hard for three reasons. On the first reason is that many of these systems rely upon imperfect sensory systems that don’t directly observe the true state of the world. We see this with autonomous cars. The autonomous cars rely on vision sensors lidar or radar. Many of these sensing modalites can be affected by a collision like a car blocking your vision of pedestrian. There may be noise, there may be sensor failures and so forth. So make good inferences about what’s actually happening can be very challenging.

Interviewer: Would you say in general that these imperfections in sensing are at the same level of human imperfections or are they more or less or just different?

Interviewee: It depends upon the sensing modality, like radar sensors. Radar sensors can see through clouds that they’re often not impact in the same way that pilots’ eyes are affected. So you can get super human performance in terms of, or along some dimensions, but sometimes not others.

Interviewer: Okay.

Interviewee: And similar kind of challenge occurs when you try to apply these AI systems to medical decision making which is more along your line of research where we have to rely upon, maybe we don’t call them sensors, but maybe we call them diagnostic tests. So we apply these different diagnostic tests maybe for trying to determine whether someone is affected with the coronavirus or whatever. But you know there’s a false positive, false negative rate and so forth. The sensors that we use for autonomy for transportation systems, they are also impacted by false positives and false negatives. For example we mean, you may think we see another aircraft but it’s not actually there, or vice versa.

Interviewer: Okay. So that’s the first pig challenges that the imperfection in the sensing which will be different from human sensing but will still have its problems.

Interviewee: That’s right. So related to that is the uncertainty in the future trajectory of reality. So...

Interviewer: There’s a lot of that I notice.

Interviewee: Haha... There’s a lot of that, especially right now in our ability to model what’s actually going on is the major challenge.

Interviewer: I believe a great baseball player once said “Predictions are difficult especially about the future”.

Interviewee: Yeah, that’s exactly right. And for many of the systems that we are interested in our lab, if you mess that up, the consequences can be fatal. So if we’re trying to make a prediction about where another passenger aircraft is going to be over the next 40 seconds, I mean, most of the time they just fly straight, right? But sometimes they might turn left, turn right start climbing or descending and we have to be robust to that variability.

Interviewer: So this is interesting as that implies that these systems does not only need to sense the current present, they have to have some memory of the past either recent or distant, and they need to have a model for the likely things that could happen, but I would guess, also the unlikely things.

Interviewee:That’s right. And many of the systems that we’re interested in involve humans in the loop. As you know humans are a tremendous source of stochastic or randomness in what happens. And so, uh, the pilots who are flying these aircraft. They may suddenly decide to maneuver to avoid a collision or may be they are oblivious to how the situation is unfolding. But you make a good point that in order to make these predictions into the future you have to keep track of what’s happening in the past. We see this come up quite a bit in automated driving. For example, if for the past 10 seconds or so someone is coming up behind us and they’re driving erratically. That will inform our predictions about what will happen in the future. So we may want to be a bit more conservative as they pass us. But maybe we don’t always want to be super conservative because that would be a odds with our efficiency.

Interviewer: This is the future of everything. I’m Russ Altman. I’m speaking with professor Mykel Kochenderfer for about some of the challenges in building these autonomous systems for transportation. So I think we’ve got 2 so far. I think I’m a good counter. We had sensor problems and we had prediction of the future problems.