ASABE's Student Robotics Competition is Thriving

Tony Grift

Editor's note: **ASABE member Tony Grift** initiated the ASABE Student Robotics Competition in 2007. Since then, he has provided steady leadership as chair of the competition committee.

Time flies when you're having fun. That's a cliché, but it's true for those involved in the ASABE Student Robotics Competition. For nine years running, it's been a crowd-pleaser at ASABE's Annual International Meeting (AIM).

I remember exactly why we started this competition. For years, I'd been spreading the gospel of need for agricultural automation and robotics. My alma mater, Wageningen Agricultural University in The Netherlands, had hosted a similar competition, although the Wageningen event took place outdoors. In 2006, I officially proposed the idea of a student robotic design competition as a recurring event at the AIM, and the ASABE Foundation generously provided seed money to get the first robots up and running. It took off from there!

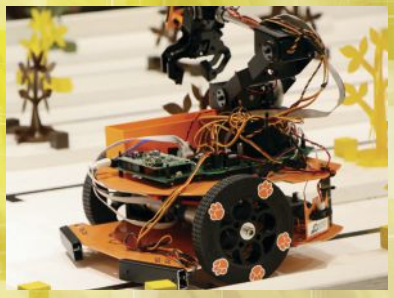
Challenges along the way

When we started the competition, and every year since, our goal was to be an exciting part of the AIM. Therefore, to be close to the AIM attendees, we were constrained to a relatively small indoor space. In addition, the robots had to be small enough to allow the teams to transport them as checked baggage.

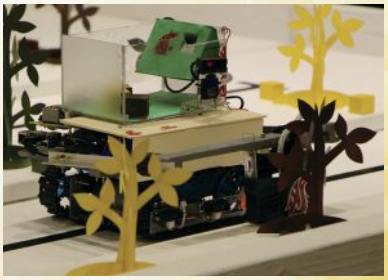
To set our event apart from other robotics competitions—of which there are many—we developed a defining factor: the competition must be related to agriculture. Over the years, we've refined that aspect of the event based on the local agricultural practices where each AIM was held, such as feeding cattle in Texas (Dallas 2012), harvesting round hay bales in Kansas (Kansas City 2013), and collecting sap for maple syrup in Canada (Montreal 2014). Next year's AIM in Orlando may inspire a competition related to citrus fruit.

Furthermore, the competition must be achievable—but challenging—for a two-person team with a limited budget, and it must offer a spectacle for the AIM attendees. For instance, we once received a suggestion about building an instrumented potato (which in real life travels through harvesting and processing machines to study the forces exerted on potatoes), but we had to decide against it. It's useful technology, but it's not much to look at. The same goes for controller area network (CAN) plug fests, where students write software according to a standard and see if two separately developed systems can talk to each other. It would make for a high-tech competition, but there's not a lot of excitement in staring at computer screens.

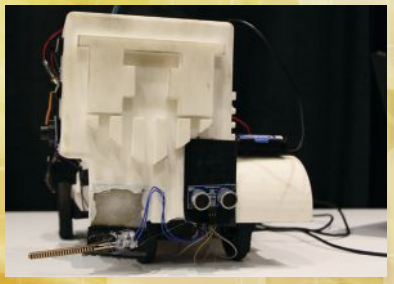
Kansas State University takes the prize.



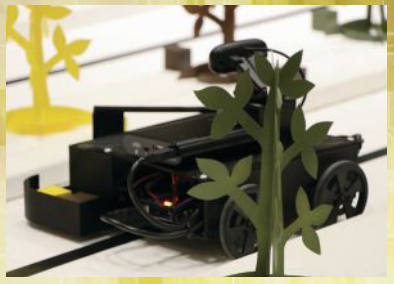
Clemson paws tackle the track.



Washington State University zips along.



University of Illinois stares down the competition.



McGill maneuvers a forest of obstacles.

Judges and **ASABE members Robert Waggoner** (AGCO), **Tony Grift** (University of Illinois), **Emily Carter** (U.S. Forest Service Southern Research Station), and **Tom Way** (USDA-ARS National Soil Dynamics Laboratory) (left to right) discuss the order in which the 2015 teams will run.

We've also considered robotic sheep shearing, but so far ASABE has been hesitant about that idea—to say nothing of the sheep.

We initially worried that finding impartial and attentive judges would be a problem, but every year we've had excellent judges. They volunteer their valuable time at the AIM to support our students and our Society. We're fortunate that, as engineers, we can build stuff that works and cheer each other on—and not every profession gets to do that!

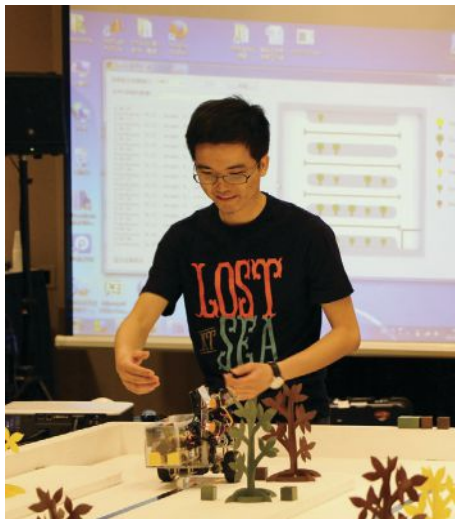
Lessons from previous events

At the first competition in 2007 in Minneapolis, we had five teams: Kansas State, Iowa State, McGill, Oklahoma State, and the University of Illinois. That first challenge involved robotic grain harvesters and unloaders. The grain was represented by BBs (4.5 mm metal balls). At the time, the robots were typically constructed using LEGO® Mindstorms components, and the controllers used line-of-sight communication. The harvesters and unloaders communicated with each other, the teams learned how to define communication protocols, and for a first attempt, it was a very good experience. We also learned that materials handling can be hilarious when things go awry, as thousands of BBs spilled onto the floor while students frantically tried to contain them.

In 2008, the challenge was to selectively harvest randomly placed "trees" (represented by painted dowels of two sizes). We assumed that the teams would build harvesters that roamed through the forest, randomly finding the right trees to harvest. Instead, Kansas State surprised everyone with a huge gantry system that did a beautiful job of grabbing only the thicker trees. The judges looked at this behemoth and wondered if it was legal, but the rules did not prevent it. It didn't represent the way such things work in reality, but nowhere did the rules say that the solution had to mimic reality! The Kansas State team had found a loophole and then capitalized on it, and there was nothing wrong with that. However, to prevent this kind of thing from happening again, we now require that the robot must fit within a cubic foot at the start and end of its run.

Jose Batz of Texas A&M readies for the team's first run of the day.

The 2011 competition in Louisville required robot harvesters to follow a row of wheat made from broom bristles—which took a long time to construct! The goal was to travel the longest distance while maintaining a constant distance relative to the wheat. To trace the machine's path, we required each robot to drop a trail of coffee particles, which had to be removed after every run. It was quite a sight: the robots running, the students sweeping up the coffee trails, and the judges right behind them. It was like a carefully choreographed performance. And it was one of the best competitions: speed, pandemonium, and students and judges trying to stay out of each other's way.



Zhejiang University sent two teams from China to compete in the competition.

Nervous excitement reigns as robots avoid trees on the obstacle course.

You'd think that, with so many constraints, it must be nearly impossible to come up with a new challenge each year. That hasn't been a problem. However, one of the most difficult constraints for the teams is the limit imposed on resources. If there were no limits, a two-person team with a $500 robot would have to compete against a ten-person powerhouse with a $30,000 budget. Of course, it's impossible to police how many people are involved and how much money they spend, but we want to give every team the same opportunity.

That brings me to Kansas State's controversial winning streak. Because KSU has won first place nine years in a row, some people have wondered if the competition is fair. Yes, it's fair. The KSU teams have come up creative ideas and amazing machines. To beat KSU, other teams must work at KSU's level, rather than force KSU to descend to the realm of mere mortals. The goal of the competition is to achieve the highest possible level of technical sophistication, presentation, and reporting—and KSU consistently does that. Kudos to them!

Looking ahead

At the 2014 AIM, **ASABE Fellow Naiqian Zhang** and **ASABE member Alex Thomasson** explained how they use the ASABE robotics competition in their coursework at KSU and Texas A&M, respectively. I'm in favor of that, and I hope other university instructors will do the same.

Judge and **ASABE member Daniel Skelton** (far right) scores the run of Cal Poly's robot, the team's first-time competition entry.

We once feared that some technologies were too advanced for an undergraduate team, but experience shows otherwise. At the 2015 competition in New Orleans, the teams did not shy away from coupling image-processing to client-server computing, communicating in five different programming languages, twittering results in real time, and generating 3D printed parts. We have also grown from a low of three teams in 2008 to eleven teams in 2015, which has required us to extend the competition to Monday afternoons and Tuesday mornings.

The future of the robotics competition looks good. As we eventually get into drones, perhaps underwater challenges, and linking up with the 1/4 Scale Tractor competition and even Fountain Wars, there's no possibility of it becoming stale. Most important, as long as we provide a competition where our young engineers can apply their energy, creativity, and resourcefulness, it will be an entertaining and educational event for years to come. And I want to see that sheep get sheared before I retire!

The Kansas State University team presents its robotic specifics.

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To learn more about the ASABE Student Robotics Competition, visit the ASABE website: www.asabe.org/awards-landmarks/student-awards,-competitions-scholarships/robotics-competition.aspx