Wired news

Androids Dream of Soccer Glory

By John Borland | Also by this reporter
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BREMEN, Germany -- Like almost everyone around me, I'm on my feet cheering. The gangly little robot Jupp, a smile fixed on his Styrofoam face, has taken the ball from a tangle of metal legs and is dribbling downfield.

Granted, it's a slow process. The crowd is chanting: "Jupp, Jupp," but it's no good. This is a goalie and his programming shows it. His shot is wide, and the stumpy Osakan robots retake the ball.

Heinz Rothgang, a local man attending the RoboCup, or Robot World Cup, tournament turns to me with a grin and pays the little players a compliment that shows just how far the wobbly little soccer players have come -- and just how far they have to go.

"It makes it clear how difficult it is just to walk," Rothgang says. "You can see how much of a task it is for kids. It reminds me of watching my own kids learn."

There's more than one kind of learning going on at this five-day international event. It's the 10th year this tournament has been held, and the 440 teams of students, researchers and high-tech companies are vying for the title of world champion in several categories of robotic soccer. They're quickly getting better at what they do.

The stated goal of RoboCup is to have a team of self-directed humanoid robots that can beat the world's best human players by the year 2050. But that's a long way away, and many participants aren't visibly working on this task at all.

One group of teams watches robots maneuver up stairs and through the simulated obstacles of a disaster site, looking for dolls and a waving arm that represent survivors. A Florida team that had participated in this event actually helped find victims after the 9/11 attacks in New York.

A huge number of young students from around the world compete in simple one-on-one soccer matches, or in dance competitions that bring awkward hip-hop and hula robots on stage to bend and twirl in time with music.

Out on the field itself, attendees say this is the first year the humanoids have really contributed to the soccer action, beyond their obvious anthropomorphic appeal.

"The walking has improved," says Tobias Ludwig, a student and robot designer for the Darmstadt Dribblers team, from the Technical University of Darmstadt. "Last year it was very slow and often boring. This year there is some action going on in the games."

Indeed, it is hard not to get excited watching Jupp's team, the Freiburg University Team NimbRo, square off against defending world champions Team Osaka.

The German team is tall and fast, at least in two-foot relative terms. In a real soccer game, their height would help them leap above defenders to head the ball into the goal. While that's probably decades away here, their long legs let them totter across the small field faster than their opponents.

But the Osakans, short, thick and deliberate, stay the course. The NimbRos have a tendency to fall down after they've kicked the ball, or when they run into an opposing player. They can get to their

feet again, pushing themselves up on their elbows and throwing their weight forward. But by the end, that instability has undermined their speed advantage, and the slower, more stable Osakans take the two-on-two ribbon.

The Germans get their revenge in a separate penalty-kick competition, however. The Osakan goalie is graceful, with a sidelong dive toward the incoming ball that would do a real goalie proud. But it is always a heartbeat too slow.

Team NimbRo's Jupp has a different strategy. As the Osakan prepares to kick, he spreads his legs wide in the splits, leaving just the edges of the goal clear. This tactic stops two shots, enough to give the Germans the edge.

For all the crowd appeal of the humanoid games, it is the small and medium-sized leagues, along with the four-legged Aibo teams, that help show the Robot World Cup as more than just a venue for wacky grad-student projects.

Researchers say soccer provides a useful, standardized way to address a wide range of issues in robotics and artificial intelligence, including behavioral programming, motion and vision. The non-humanoid robots, without the difficult task of staying upright on two legs, have more freedom to experiment with behaviors and environmental responses.

Some focus on passing, others on reactive motion or more esoteric behavior. The FU-Fighters, a team from the University of Freiburg in Germany, have come into the middle-sized league this year with a new chip shot that can launch the ball most of the way across the field, further than the strongest of their rivals.

But this league is fast and brutal and even virtuosos can tire. The players smash into each other and into the goal. After nearly a dozen matches over four days, the FU Fighters team is damaged. In their final match, vying for third place against the Japanese team from Keio University, one player begins to spin and has to be taken off the field. The goalie mistakes the yellow goal for the orange ball, and hurls itself against the wooden posts, tearing up the green field.

Freiberg professor Raul Rojas is philosophic about the loss. It's a rough game, and the team that can keep the most robots on the field tends to win, he says. Until someone creates a better "vision" than simple color recognition, the improvements will likely be small.

Already a few teams are working on stereoscopic vision, which would help with depth perception. Next year, the humanoid robots are likely to leave behind their Pocket PC brains, which most teams have used for weight reasons.

"Every year the teams get better and better, but there's no quantum improvements this year," Rojas says. "It has been a continuous evolution."

Maybe so. But on display in one corner of the Darmstadt team's workspace is a 51-inch-tall vision in pink that just might be the missing link. I fall in love with her at first sight.

Her creator, Darmstadt student Robert Kratz, introduces us. She's Lara, like *Tomb Raider*'s Lara Croft, he says with an embarrassed smile. But if anything, she is vaguely reminiscent of the shapely android from Fritz Lang's *Metropolis*, not the busty video game heroine.

Lara is built on an innovative theory of movement, with elegant wire muscles instead of the motors that drive her (obviously male) peers. Between each of her joints, Kratz has drawn several thin strands of a metal alloy that contracts if heated to 90 degrees centigrade. Pulses of electricity heat and shrink the wires, pulling a leg or arm up.

The strands cool and expand almost instantly, producing muscle-driven motion much like that of a human.

Unfortunately, Lara isn't quite ready to play soccer here. Her pink-and-white shell, designed by students at an art university in Offenbach, was delivered only a week ago. She was able to stand on one foot and kick a ball a few days ago, but she's not ready to compete yet.

Maybe next year, Kratz predicts.

"RoboCup isn't the primary goal of this research," he says. "But it's a good test."