Cue the Flying Robot Fairies!

An Exploration of an Interdisciplinary *A Midsummer Night's Dream*

"*But room fairy. Here comes Oberon."*
"And here my mistress. Would that he were gone!"

Oberon, fairy entourage in tow, enters the scene, ready to bring his disobedient wife Titania to heel. Suddenly, Oberon ducks, and his fairy entourage drops to the ground, squealing in surprise. A loud whirring sound drowns out any other noise. Swooping over the heads of her master, Oberon, and her fellow fairies, Virginia makes her entrance.

Virginia is an AirRobot, a quad-rotor flying robot about three feet in diameter. Utilized for Robot-Assisted Search and Rescue missions, Virginia and those like her are sent into crises to provide humans waiting for rescue with information and supplies. This robotics work is the specialty of Dr. Robin Murphy, Raytheon Professor of Computer Science and Engineering at Texas A&M University, where this production of *A Midsummer Night's Dream* is taking place.

Out of harm's way for the months of October and November in 2009, Virginia, and a rotating corps of six Micro-Heli robots, themselves the size of toy helicopters, treads the boards as fairies with their human actor-counterparts.

As the director of this *Midsummer*, I was responsible for fostering collaboration between faculty and students in the Departments of Performance Studies and Computer Science and Engineering (CSE). Within the production, making human and robot as co-character work conceptually and dramatically was the major issue. From this primary issue, there were secondary issues of how to introduce the robots to the audience as actors, rather than as animate props; managing audience response to the robots; and, linking the fairy humans and fairy robots together through costume and sound design. Solving these issues, plus staging and designing a theatrical production was a tremendous challenge for the Performance Studies and CSE faculties; but, both sides learned an equal amount from the other about what was possible in stretching technology and in redefining the thinkable.

Fig.1. Virginia, in costume, with all the fairies. Photo by Jane Martin.

In the end, inserting the robots into *Midsummer* was not as hard as we expected; making the fairy humans and fairy robots link together visually as similar beings turned out to be the biggest practical challenge we faced. The focus of this article is the process we went through as a production team in engaging with the challenges noted above and what lessons we take with us moving forward.

While there are many universities around the world with departments and areas in Robotics—University of Southern California, Stanford, Harvard, Brown, the National Taiwan University and the University of Bonn, to name a very few—theatre productions with humans and robots on stage together as co-actors are rare. Within the past several years, three international productions serve as examples of the robot as cold and inferior other. In contrast, the A&M production worked towards an acceptance of the robot as an equal and intentional participant in the story.

Japanese playwright Oriza Hirata's play *I, Worker*, a 20-minute domestic drama with two humans and two robots, ran at Osaka University in November 2008. (Unsigned BBC n. pag.) In May 2009, Swiss theatre director Christian Denisart premiered his musical *Robots* in Servion, Switzerland, which included two human and three robot actors in a silent movie-style take on the Pygmalion story. (Bradley n. pag.) Quebecoise artist Nathalie Claude premiered *The Salon Automaton* in December 2009 in Toronto. Starring the artist as the host of a literary salon and three robots, dressed as 19th century automatons, the production explored the theme of loneliness in modern society. (Broverman n. pag.)

As robotics technology develops, the dramaturgical questions to be asked and answered are myriad: how does spontaneous acting between human and machine occur if the robot's staging and spoken lines have to be programmed beforehand? How does costume design work on a mechanized performer? In order to accommodate lighting design does the robot have to have a shell of non-reflecting material? What is the role of director as it concerns robot actors? Is there an understudy robot at the ready, just in case the lead robot actor breaks down? How does the audience relate to a mechanized performer?

The "Other" that a Robot presents is outside the bounds of immediate control or persuasion. While it might be easiest to conceive productions of traditional Western-canon plays that cast the robot as servant or background player, raising the stakes of co-acting by casting a Robot as Torvald to a human Nora surpasses "edgy" and goes to a place where success is not assured. The visceral nature of that question: 'will it succeed?' would infuse a production with the drive and verve that is sometimes so lacking from contemporary theatre performance.

Simply attempting to answer these questions as an academic exercise might be enough to justify the use of robots as co-actors with humans in live theatre productions. As this kind of production relates to university-level Educational Theatre, the opportunity for interdisciplinary and experiential learning in the fields of acting, directing, scenography, computer science, computer engineering, and electrical engineering is a doorway into understanding new realms of organic and non-organic intelligences in live performance for both students and faculty. In this economic climate, especially as a small

arts department (Performance Studies) at a large engineering and agricultural school (Texas A&M), this kind of intriguing and publicity-generating collaboration is a tide that raises departmental boats above the most severe of budget cuts.

From a theoretical point of view, the production presented three major questions: 1) Will the robots help or hinder the audience experience of the production? 2) How will the audience respond to flying robot fairies in their midst (sometimes literally over their heads)? 3) How can the human and robot actors interact in a way to give the maximum impact to the characters and the story?

In answering these questions, there are several terms from the robotics field to define: 1) Affect: describes the level of relative emotion a robot can convey. In this production, we were looking to produce clear Affects, and wound up able to portray happiness, menace and mischief. 2) Social Actor: human perception of the robot is of a machine with intention or will. 3) Inanimate Prop: human perception of the robot is of a simple object, able to move or react only through pre-programmed commands. (Nass 36.) Our production hoped to create a robot coterie of Social Actors, rather than Inanimate Props.

Speaking to the question of human perception of robot-driven action, especially as it pertains to theatre, Cynthia Breazeal, Director of the Robot Life Group at MIT, notes, "Good actors often say that half of acting is reacting. Hence, a robot actor must be able to act/react in a convincing and compelling manner to the performance of another entity, whether human or robot, as it unfolds. This requires sophisticated perceptual, behavioral, and expressive capabilities."

Understanding and providing robots with these "sophisticated capabilities" is where Dr. Murphy and her team in CSE come in to play. Featured in June 2010's *US News and World Report*, Dr. Murphy speaks about the difficulties of preventing humans from panicking when approached by a robot in a rescue situation. "Robots don't make eye contact. Their tone doesn't change. When they get closer to people, they start to violate their personal space. The term that keeps coming up is 'creepy.' People find the robots that are supposed to be helping them creepy."

It was Dr. Murphy who first proposed collaboration between CSE and Performance Studies in January 2009, as a way to help her graduate students become

better at understanding extremes of human emotion, which in turn, would lead them to better replicate those emotions as Affect in robots. The better the graduate students are at understanding and replicating Affect, the more effective, and less "creepy", robots can be in rescue and crisis situations. *Midsummer,* already programmed for the Fall 2009 season, provided the best opportunity for such a collaboration.

From that initial conversation, the CSE team joined the production and two or more from their group attended every production meeting from the first in August 2009 to the post-mortem in November 2009. Every performance was filmed to collect data on audience response, in the form of physical movement and emotional expression, to the robots. During the scenes that included the fairies—the scenes that the robots were in—the robots were incorporated into staging and choreography the same as the actors, and received character notes about the Affect best needed for any given scene. One robot even got a stand-alone scene, mocking and laughing at Bottom as he awoke from his dream. It was important to all of us on the production team that the robots be fully integrated into the production, rather than shoehorned in during tech week.

In moving from theoretical questions of audience response and robot Affect to the production itself, practical and specific questions arose regarding bringing the audience into the experience and accepting what they see; a directorial concept incorporating robots; and, linking the robots, via design, staging and use of Affect, into the production as Social Actors.

The production opened with a prologue dance number, featuring all the fairies, both human and robot. For this prologue, the 11 human fairies and 6 robot fairies entered in groups from backstage and through the audience, dancing to original music. The added prologue introduced the audience to the robots in a way that did not stop plot action. Including this prologue dance number brought the audience into the world of the play, and the inclusion in that world of supernatural fairy characters, both human and mechanized.

With very limited backstage space, a human cast of 25 and two large construction scaffolds onstage, the pilots were in full view of the audience, and the robots took off and returned to areas of the audience space. Virginia's pilot stood in the house-left vom, part of which also served as her launch pad. The Micro-Heli pilots sat in chairs in a row

directly above the house right audience seating. Also, the pilots needed to see their robot in order to fly it successfully—keeping it away as best as possible from people, lighting instruments, set pieces and large air conditioning vents. Of course, visible pilots are nothing new to contemporary theatre—audiences easily reconcile the performances they are watching with the visibility of puppeteers in the musicals *Avenue Q*, *The Lion King*, or *Finding Nemo*.

There were two determining factors regarding audience reaction to the robots: if an audience member encountered a robot personally, for example, when it crash-landed in a lap; and, if that encounter was before or after the audience member saw an actor handle a robot. The actors playing Titania's fairies (Moth, Cobweb, Peaseblossom, etc.) were paired up with a Micro-Heli and had responsibility for their Micro-Heli during performance. The human actor made sure their robot got on and off stage at the right time, and, if necessary, retrieved their robot from the audience. The human actors also interacted with their robots on a personal level.

Data noting Micro-Heli flight time, crash incidents and crash locations taken from CSE videos of performances showed that if an audience member had a robot crash into them at the very top of the show, or the top of Act 2, Scene 1, they would usually treat the robot like a toy by handling it roughly. After the audience had seen how a human fairy would interact with the robot, treating it like a beloved pet or mischievous child, the audience member would behave similarly. (Murphy et al 150-151) In order to launch the Micro-Helis into flight, the pilots and actors placed the robot skids-down on their open, flat palm. Audience would imitate this action, once they had seen it, to get crashed robots back in the air. This is a small but important difference. The audience, over the course of a performance, changed their perception of the robots from Inanimate Props to Social Actors. (Murphy et al 152)

Directorially, the concept of this *Midsummer* blended contemporary and classic elements. The world had to accommodate futuristic robots, immortal fairies, a love quadrangle, blue-collar yahoos and ancient mythological heroes, giving the play a timeless quality, outside of a set historical period. Generally, this concept translated into a technology-heavy costume design; and, a sound design that used video-game controllers

to create a live sound-scape for the fairy world. The costume and sound designs were responsible for the majority of the visual linking between human and robot actor.

Fig. 2. The set, designed by Jean Daniels, was a black floor with a full moon painted center stage, a star drop against the back wall, and two construction scaffolds, distressed to look rusty with age. Photo by Jane Martin.

Costume and lighting designer Autum Casey needed a way to place the Micro-Helis clearly in the world of the play as fairies, and not just as flying toy helicopter-sized robots. She also needed to differentiate each member of the robot hive and connect them by color to a corresponding human actor.

The most obvious example of this linkage used differently colored fiber optic lights in the human fairy costumes—in the trim detail on a skirt, the lining of a hooded sweatshirt, in the folds of a ruffle or worked into a wig. The fiber optics in the human

costumes mirrored the Micro-Helis' own LED light at the front of their internal structure; however, the Micro-Helis were more problematic in their costuming. Their internal structure could only hold so many ounces of weight before they were unable to lift off.

The solution to the problem of costuming the Micro-Helis, discovered after several attempts, was in constructing a shell, about two inches wide by eight inches long, of plain white cardstock. The shell had a metal snap closure at both ends, to facilitate its placement on, and removal from, the robot. Attached to the outward facing side of the cardstock was crumpled colored cellophane. The cardstock had a hole placed so that it matched up with the Micro-Heli LED. This light illuminated the cellophane and made the robots glow, which made them visible to the actors, audience and pilots.

Fig. 3. The fairies and micro-helis. Note that the green fairy has a yellow-costumed micro-heli in her left hand. Photo by Jane Martin.

Dr. Jeff Morris supervised sound design and technology. His solution for linking the human and robot fairies via sound appeared in the form of Wiimotes, the video game controllers that sense and react to human movement. The Wiimotes provided the opportunity to create sound, generated by the actor, amplified to sound robotic, thus aurally linking the human and robot fairies. Dr. Morris and his team installed a visible Wiimote on Puck's broom, which Puck used as a magic wand: turning Bottom into a donkey, creating fog to disorient the lovers, etc. As Puck moved the broom off its vertical axis, it created an electronic swoosh sound that could speed up or slow down, depending on how fast the broom moved through space. Securing the Wiimote inside the broom's bristles did not work and camouflaging it on the broom handle only seemed to make it more obvious, so the decision was made at logistic and aesthetic levels to leave it out in plain sight.

Oberon and Titania also had Wiimote capability, in that they could affect one another—and other fairies and Bottom—by using a physical gesture vocabulary developed by the two actors. They could stop, freeze, wound, silence, hold, brush off, peel off, put on the ground, pick up, pull towards, push away and sexually arouse via gesture. The costume design sketches by Professor Casey incorporated components of the Wiimotes into the elaborate cuff bracelets worn by both characters. Unfortunately, Dr. Morris and his staff were unable to break down the Wiimote beyond its white rectangular casing and still have it communicate with the sound booth equipment. This idea of sound connected to gesture vocabulary was not something anyone was willing to sacrifice; so, during performances, the sound board operator, using two Wiimotes, one for Oberon and one for Titania, along with a highly detailed spreadsheet noting each gesture, cue line and meaning, performed Oberon and Titania's Wiimote sounds live.

Fig. 4. Oberon and Puck. Note the white Wiimote taped at the bottom of Puck's broom handle and Oberon's cuff bracelet. Photo by Jane Martin.

Staging the robots within the rehearsal process was surprisingly easy. Because the robots were at every necessary rehearsal, the pilots increased the precision with which they used their controllers, which made this aspect of the production—robot flight, movement and emotion—work beyond all our expectations.

The Micro-Helis were present with their human counterparts at all times, in the prologue, all of Act 2, 3.1, 4.1, and 5.1. Within the scenes, Dr. Murphy and I would talk during the staging rehearsals and production meetings to determine what Affect was needed from the Micro-Helis. Virginia, with her brief appearances, displayed some dance moves during the prologue and 5.1, but otherwise was not a part of the Affect conversations.

Affect was not dependent on the robot alone. The human and robot actors worked as teams, synthesizing their emotional states within the action of the scene to provide the

strongest portrayal of Affect possible. This necessary synthesis is noted by Indiana University robotics researchers Robert Rose, Matthias Schuetz and Paul Schermerhorn in their paper, "Empirical Investigations into the Believability of Robot Affect." In the paper's introduction, the authors state, "'Believable' refers to an intrinsically relational property, a ternary [threefold] relationship to be precise: whether or not an artificial character is believable depends on the ones who would find it so as well as the context of the interaction…"

The three Affects developed by the pilots were happiness, menace and mischief. A display of happiness from a robot was a slow rotation or bounce in mid-air. Bounce occurred as a rapid change in robot altitude by the pilot. Robots flying with their noses at an extreme downward angle and at a fast rate of speed displayed menace. Mischief showed up as a very fast rotation, interspersed with a bounce. Of course, highlighting these Affects, and their perception by the audience, depended on the emotional states of the human fairy actors. When a band of fairies is commanded by their newly infatuated Queen to "*Be kind and courteous to this gentleman./Hop in his walks and gambol in his eyes;"* the robot Affect is reflexive of the human's intention and emotion. It is that synthesis of human and robot actor that aided in the audience perception of the robots as Social Actors, as true characters in the scene, and not just as flying novelties, easily dismissed and forgotten.

Conclusion

"I am sent with broom before,
To sweep the dust behind the door."

The production was reviewed in the Texas A&M student newspaper, *The Battalion*, receiving a positive appraisal from the student-journalist, Anthony Gerhardt. Gerhardt concluded his review, "*A Midsummer Night's Dream* is a retelling of a classic tale that's made unique with the successful collaboration of multiple academic departments. You'll be intrigued with the play's use of robotic technology and entertained by the charm of the actors and dancing." While the first weekend was well attended, the second weekend took everyone by surprise. With performances Thursday

through Saturday nights and Sunday matinees, the second weekend completely sold out by the afternoon of the second Thursday. Write-ups of the production appeared on Wired.com, Gizmodo.com and Engadget.com, each within a couple of days of the production's closing in mid-November 2009. In February 2010, Science Friday (a nationally-syndicated NPR program) featured *Midsummer* as a Video Pick of the Week on their website with footage from the show and an interview with CSE doctoral student Kevin Pratt. In April 2010, this article's author gave the keynote address, focusing on this production, at the University of Wisconsin Theatre and Drama Graduate Student Conference.

While the praise was extremely flattering, the production did more than just garner some national press for all involved. It proved that robots could be incorporated dramatically into a production (even a classic of the Western Canon), they could present Affect in a compelling manner and, finally, be perceived as Social Actors by an audience. The data produced helped further the research and development of Rescue Robotics. Actors stretched their performance muscles in working with acting partners that were non-human and not always cooperatively airborne. Finally, a largely college student audience was re-introduced to Shakespeare in a contemporary and unique way.

Further questions remain for exploration and experimentation: what other Affects can be developed? What other kinds of roles can robots take on? How can robots take on more of a character, perhaps even with lines? How can that happen with as little pre-programming as possible? Will a robot as major character (Torvald, Marisol, Gypsy Rose Lee) ever be believable to a human audience? Our budget and timeline are not unreasonable or unreachable by most, and the experience gained by all involved is not long forgotten.

Works Cited

The author thanks Alison Christy, Brittany Duncan and Bethany Wood for their help with this article.

"Actor Robots Take Japanese Stage." *BBC News Asia-Pacific*. British Broadcasting Corporation, 26 November 2008. Web. 29 June 2010.

Bradley, Simon. “Robots Steal the Musical Show.” *Swissinfo*. Swiss Broadcasting Corporation, 6 May 2009. Web. 29 June 2010.

Breazeal, Cynthia, et al. “Interactive Robot Theatre.” *Communications of the ACM* 46.7 (2003): 76-84. Print.

Broverman, Alison. “Nathalie Claude, The Human Star of a Three-Robot Show.” *Thestar.com*. Toronto Star, 26 November 2009. Web. 28 June 2010.

Cimons, Marlene. “New in Rescue Robots: Survivor Buddy.” *US News and World Report.* US News and World Report, LP., 2 June 2010. Web. 30 June 2010.

Gerhardt, Anthony. “*A Midsummer Night’s Dream* is a Successful Team Effort.” *The Battalion.* Texas A&M University, 9 November 2009. Web. 28 June 2010.

Murphy, Robin, et al. “A Midsummer Night’s Dream (with Flying Robots).” *Autonomous Robots* 30.2 (2011): 143-156. Print.

Nass, Clifford. “Etiquette Equality: Exhibitions and Expectations of Computer Politeness.” *Communications of the ACM.* 47.4 (2004): 35-37. Print.

Rose, Robert, et al. “Empirical Investigations Into the Believability of Robot Affect.” *hri.cogs.indiana.edu*. Indiana University, 2008. Web. 30 June 2010.