Puppet Evolution: Film & Technology

by Lisa Aimee Sturz, with Jeffrey Jacobson and Tim Lawrence

- Over the last several decades, technological and mechanical innovations have dramatically changed the way puppets are brought to life.
- Nowhere have puppetry forms and methods of movement changed faster, more relentlessly, more creatively than in the realm of puppetry for the film and television screens.
- And Lisa Sturz has lived many of those changes and challenges firsthand, as both a builder and performer.

Puppetry has gone through many transformations since its mysterious origins in the world of folklore and magic. Early puppets were made from wood, clay, bone, ivory, beads, feathers, leather and natural fibers. Today's puppet builders often include foam, fabric, aluminum, latex, polyurethanes, lightweight carbon fibers and plastics. Those working in the film industry add a specialized knowledge of servomotors, telemetry suits, waldos. With recent digital technology, puppeteers have the ability to manipulate space and time inside a new silicon universe of simulated reality. Today, puppetry is carving out its place in the digital age using a blend of gaming technologies and computer generated images that exist only in our virtual world.

The one constant – the one thing that hasn't changed despite all of the make-overs– is the role of the skilled puppeteer in bringing figures to life and giving them character, emotion, and personality.

PUPPETS IN FILM

Traditional puppets were popular both in 20th Century films and in the early years of television. In the 1950s a few puppeteers were admitted to the Screen Actors Guild (SAG) as specialty acts. *The Sound of Music* featured the classic marionettes of Bil Baird's, Burr Tillstrom broke into television with his hand puppets in *Kukla, Fran and Ollie*, Frank Paris created the original Howdy Doody, which was replaced by a puppet built by Velma Dawson and later by Margo and Rufus Rose. The mouse Topo Gigio created by the Italian Maria Perego was a regular on the *Ed Sullivan Show* and Shari Lewis's Lamb Chop was well-liked among the children.

With the popularity of shows like Jim Henson's *Sesame Street* and the *Muppet Show* in the 1970s, on-camera puppeteers required specialized training working with monitors to master precise eye focus, lip sync, body posture, and expressive hand motions. As the industry began incorporating mechanical eye movements and blinks for close-ups, puppet performers developed versatility with external controls such as rods, strings, and cables. Within SAG, puppeteers were upgraded to principle performers with the same benefits and residuals as traditional actors.

In pre-digital Hollywood, if your film required a fantastic character, you had few choices of how to achieve it: puppets, costumes, or stop-motion animation. Each of these approaches had advantages and drawbacks and the best effects were often a combination of all three. Often the choice involved how much of the character the camera needed to see. If using a puppet, one needed to disguise or hide the puppeteer and their controls. Puppeteers were stuffed into plants, hidden under floorboards, or squeezed behind furniture while operating a puppet over their head and responding to the video feed on a monitor behind them. These contortions were somewhat alleviated in the 1980s, as technicians learned to use the 'Harry Paint Box' television graphics system for rod removal in post production. This allowed puppeteers to perform more freely with heads and rods entering the frame, leading to the popular expression, "We'll fix it in post." (http://en.wikipedia.org/wiki/Quantel)

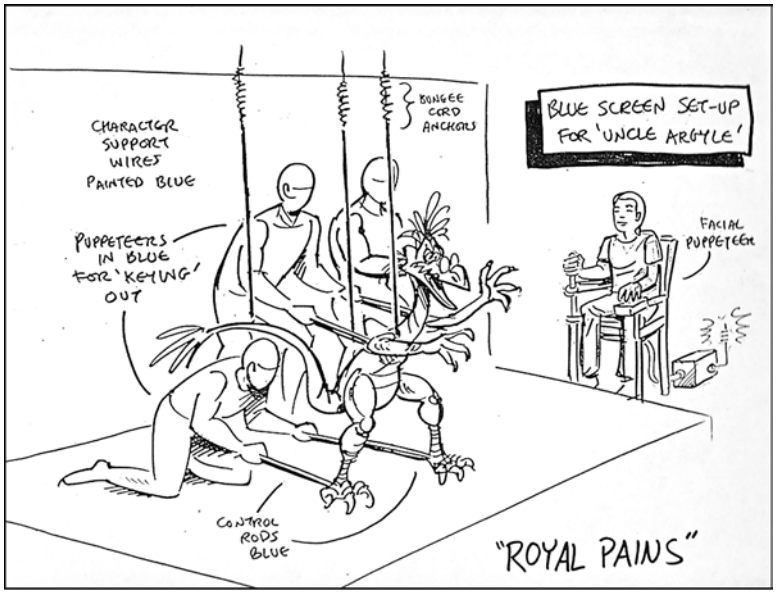


Illustration by Pete Von Sholly

Another innovation of the time placed puppeteers clad in colored body suits in front of matching blue or green screens. They manipulated their characters, taking care not to move a rod or hand in front of the figure. The puppeteers were keyed out in post-production and the performance was then layered into a previously filmed scene. It allowed full bodied figures to inhabit more complex scenes but was touchy to light and restrictive to the performers.

Lisa Sturz (in blue suit) working "Archy" assisted by Wendy Morton (left)

By the 1980s and 1990s, technology was advancing quickly. Household computers were becoming the norm and a rare breed of young geeks was learning to navigate, improve, and create software. This new generation matured during the beginning of *Sesame Street* and *The Muppet Show* and many had become die-hard fans. They grew up playing with mechanized gadgets and robots, and dissected radios, televisions, and computers for fun. As they entered the work force, many found a home in the motion picture industry just as the film elite were nurturing society's appetite for fantasy, horror, and alien productions. The fur-friendly hand and rod puppets of *The Muppet Show* were being replaced by more realistic latex figures with articulated expressions and mechanized controls.

THE INSIDE TRACK: A PERSONAL MEMOIR

I was lucky to be among a group of puppeteers in Hollywood who lived the transformation first hand. Many of us were also puppet builders who free-lanced at the various creature shops popping up all over Southern California and Marin County. We often were hired because we had been practicing with and trouble-shooting the figures as they were being created. We stumbled through each new development and became versatile with change. Sometimes the puppets worked smoothly supporting our performer's instincts. But often, the interface was counter-intuitive with a back-and-forth lever controlling up-and-down movements of the puppet. We had to adjust quickly under pressure as the time-is-money clock raced and producers checked their watches. Hand controls morphed from wooden toggles, to pistol grip triggers to custom remote controlled (RC) thumb contours and hard-wired telemetrics that allowed one person to do what three or four had done previously. We breathed deep and did our job.

In 1984, legendary make-up artist Rick Baker was nominated for an *Oscar* for his fantasy chimps in *Greystoke*. (http://www.imdb.com/name/nm0000711/awards). Rick developed a facial control called the 'lip-loop' which helped produce a wonderful range of expressions in the foam latex faces. The cable-and-lever mechanism required teams of puppeteers to operate. A few years later he received the award for *Harry and the Hendersons*, using primarily remote controls that reduced the number of puppeteers needed. Rick worked the lower lip, Tim Lawrence was the upper lip and Tom Hester worked the brows while Kevin Peter Hall acted inside the suit. For the television version, the sole puppeteer, Brock Winkliss, rebuilt the controls into a special 'quad-box'.

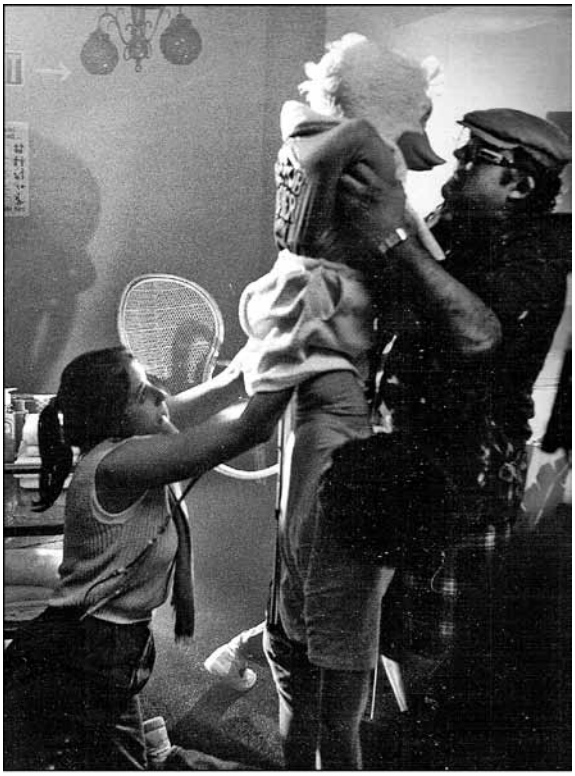
Captain Eo

My first Hollywood movie, *Captain Eo and the Space Knights* (produced by George Lucas), was filmed in 1985. Several of the puppeteers from Rick Baker's shop auditioned and we quickly became close friends. One of my puppets was the two-headed Geek. It had a heavy elaborate mechanism to open and close the mouth and move the head up and down. After rehearsing for several hours, I asked Bruce Schwartz, our lead puppeteer, for permission to remove it. He agreed. I was able to get more expression just using my hand. The device was awkward and unnecessary, but it was a step in a new direction. In that same production I learned to master cable controlled eye mechanisms, which allowed the characters to look side to side and blink. The film featured a small cable controlled animatronic creature designed by Rick Baker's Make-up and Effects shop. Their main creator, Tom Hester, skillfully operated Fuzzball's complex cable controls.

Meanwhile, in England, a Henson protégé of special effects designer Faz Fazakas, Tad Krzanowski, was revolutionizing remote-control performance. There had been much discussion about R/C vs. 'hard-wire' and their controls during Dark Crystal (1982) but it was on Labyrinth (1986) that the ideas, schedule and budget came together for the first time. Tad's engineering genius shined through the character 'Hoggle' - a marvel of technology. Any remote control, single-person performance podium you see today is still heavily in debt to Tad's original designs.

Howard the Duck

Later that year, I started work on Lucasfilm's production of *Howard the Duck*. The puppets were built in The Creature Shop at Industrial Light and Magic (ILM). Tad fashioned remote control eye blinks and facial expressions to within a micrometer of accuracy. Tim Rose held up Howard's body and worked his head while Steve Sleap worked eye blinks and other facial moves remotely. I manipulated Howard's hands and had a tube in my mouth to make him breathe. We worked carefully together like chamber musicians, planning our movements to attain a natural blend. I also had some opportunities to work Tad's remote controls animating Howard's face during scenes in which a little person worked inside a full suit (Ed Gale or Jordan Prentice).



Lisa Sturz puppeteering Howard the Duck

We carefully controlled the character's eye blinks, before changing focus or coming up with a thought. It used more mental/mechanical focus than performing directly with a live puppet, but Tad's interface helped the movements flow.

The Energizer Bunny / Short Curcuit

Eric Allard's All Effects Company (http://allfx.com) designed and built the Energizer Bunny. The bunny had several servomechanisms built into the body and actually ran on Energizer batteries stored inside the drum. I maneuvered the remote control figure for several commercials. Eric's technology allowed me to quickly change directions and spin the character in circles. All Effects also built the telemetry suit that moved Johnny 5 in *Short Circuit* in 1986. Gordon Robertson puppeteered the robot for the movie, but I wore the telemetry suit for some public appearances. With the suit on, my limb movements were translated electronically to the robot. I had to practice a bit to account for any slight delays or exaggerations, but it was easy to get the hang of. Even though the suit could translate my movements accurately into the puppet, it still required thought and seasoned performance skills to determine the scale, mood, and intention of each interaction.

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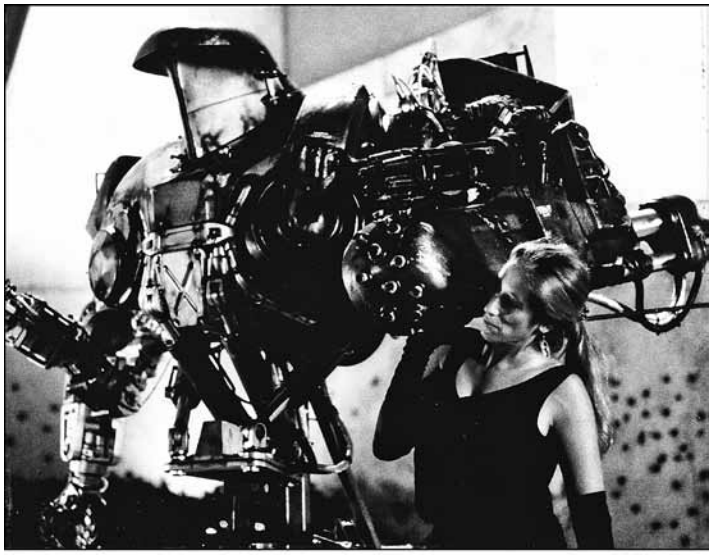
The Henson organization was front and center with the creation of the first modern digital puppet, 'Waldo P. Graphic', in 1988. Before its use in puppetry, "Waldos" referred to the mechanical arms, telemetry, and other anthropomorphic gadgetry of the NASA space fleet. Designer Kirk Thatcher created a mitten-like motion-capture device called a Waldo, which was controlled in real time by a puppeteer wearing a skeletal framework standing twenty to thirty feet away from the actual set. The computer image of Waldo was mixed with the video feed so it could interact directly with physical puppets. Puppeteer/engineer Rick Lazarrini took the idea a little farther. When faced with the challenge of making a head of lettuce spring to life for a Kraft salad commercial, he attached sensors to a helmet, and affixed additional sensor probes to his face. He routed the wires through a computer circuit board and attached servomotors. When he raised his left eyebrow, his on camera doppelganger did the same.

RoboCop2

In 1990, I was hired by Phil Tippett as a puppeteer for the nemesis character in *RoboCop2*. At the audition, Phil explained that the puppet was a big gawky machine, requiring performers with mechanical dexterity, precision and stamina.



Lisa Sturz with the Nemesis in RoboCop2

I showed him the forklift license I had acquired while working for Walt Disney Imagineering. That, combined with the fact that I had ridden my bicycle from Hollywood to Santa Monica, got me the job. Once on set, we were armed with adjustable wrenches so we could loosen the appropriate joint just before "Action." We did several all night shoots in the warm Texas location so I decided to dress for the occasion with an elegant black sleeveless shirt with long black evening gloves. A candid photo made it into *Premiere Magazine*.

On Creating "Waldo C. Graphic" by Kirk Thatcher

I met and started working with Jim Henson in 1987 after working at ILM in the early 80's and watching the birth of Pixar and the dawn of computer generated characters for film.

Jim and I were both excited about was how computer graphics were going to change and advance the way characters were done for films and television and Jim had already spent a lot of money on the computer generated owl for the opening of Labyrinth. We were both interested in seeing how computer generated characters could be performed and manipulated in real time by puppeteers, a/la hand or rod puppets but without the constraints of physical materials or the hiding of the performers.

That was the promise of computer generated puppets, no restraints on the design due to physics! On the other hand, computers were still fairly slow in terms of handling the tremendous amount of data gathered during a live performance so we decided a flying character without arms and legs would be a good start...A flying head more or less, where the performer could focus on the performance of the face and mouth and the computer wouldn't be bogged down with all the arm and leg motion data. So that's why Waldo looked the way he did, we couldn't overwhelm the computers with too much information.

It was tremendously expensive to develop Waldo for the Jim Henson Hour television series, but the little weirdo ended up being the perfect character to use in the Muppet 3D attraction at Disney World due to his being computer generated and easily converted to stereo vision 3D. He could fly right out over the audience and interact with them much more convincingly than a traditional Muppet could, and we didn't have to do an awkward green screen set up to hide any performers, which was always a lot of work and tended to still look odd.

Sadly, Jim passed away soon after and the work we had done was put aside for a while, but ultimately became the basis for the Henson Digital Performance System, or H.D.P.S, which is now used to control both real world rubber creatures and completely digital characters like the ones in the PBS series the Henson company produces, "Sid the Science Kid".

Gremlins 2

Later that year, I helped with some background shots for *Gremlins 2: The New Batch* designed by Rick Baker who was determined to improve the mechanical controls that Chris Walas had created for the first movie. Most of the characters were slick latex foam, and fur covered hand-and-rod puppets with a fluid cabled eye mechanism. I was working one of many characters in crowded scene while the 'Brain Gremlin' sang New York, New York. Tim Lawrence was in the lead operating the body and head while Steve Sleap assisted on the arms. Mark Setrakian worked the Waldo-inspired mechanism built to create accurate lip synch and subtle expression as Tony Randall's voice rang through the playback. Mark Wilson and Tom Hester operated the eyes, lids, brows, and ears by remote control. Everyone performed together in perfect harmony. It was epic.

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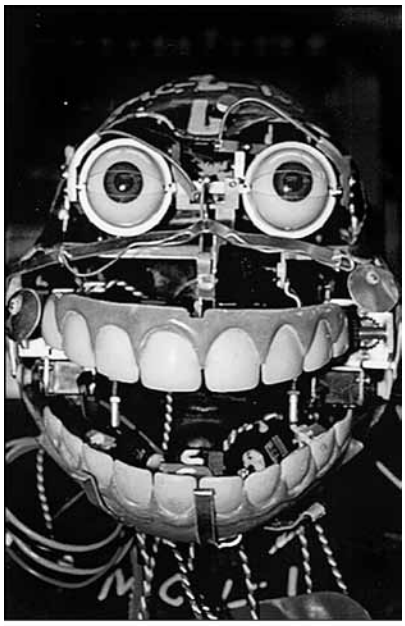
Film puppetry changed so much in one decade that producers started questioning puppeteers being paid as actors. Producers argued that the animatronic figures were special effects and should be under the jurisdiction of IATSE, the technical union.

In 1991 the Screen Actors Guild set up a National Puppeteers Caucus to define what an on-camera puppeteer does, discuss changes in the industry, and set professional guidelines. That summer, I co-authored the article, *On Camera: SAG Puppeteers: The Modern Practice of an Ancient Art* (with Mark Bryan Wilson) for the *Screen Actors Guild* magazine, which addressed new technologies including cables, radio control devices, hydraulics, pneumatics, electronics, and Waldos that replaced or augmented more traditional hand operated puppets.

The final showdown was well attended. We puppeteers introduced our position with a simple hand and mouth puppet character performed by direct manipulation. The puppet loosened up the crowd with humor and style and everyone agreed it was a worthy performance. Rick Lazarrini had prepared several versions of the same puppet that were each controlled differently. We puppeteers worked out an identical routine that we performed consecutively by hand, cables, and remote control. The Caucus concluded that puppeteers should continue to be credited as principle performers because they take direction from the film director and create dramatic performances the same as actors do.

Ninja Turtles III

In 1993, I was one of three puppeteers for Master Splinter in *Ninja Turtles III* built by All Effects (Henson Productions had created the figures for the first two Ninja Turtles movies in which Splinter was controlled by Kevin Clash). Tim Lawrence moved the head and body. I was light, agile, and strong with long arms, and was once again cast to manipulate the hands. I had to reach around Tim's body and strain to see a monitor off to the side. James Murray voiced Splinter while working the mouth and facial expressions remotely. It took a lot of discussion and coordination to work and breathe as a team. Tim and I could talk to each other directly, but we had to communicate with James via headset. All three of us studied the video feed to modulate our performance as it was being recorded. We often used playback to review and refine our movements. We worked closely with the four turtles and timed our gestures with theirs. Each turtle had a physical performer inside the suit and a puppeteer outside watching the performance on monitors while manipulating the complex mechanics that gave expression to the faces.



Above:
Puppeteers remotely controlling the facial expressions for Ninja Turtles (Left to right, Jim Martin, Noel MacNeal, Gord Robertson, Rick Lyon)

Left:
Skinless Ninja face built by All Effects.

The Flintstones

Later that year, I was on a team of puppeteers working on The Flintstones. Our first shot was to manipulate a fifty-foot long brontosaurus. We had a dozen puppeteers carefully spaced inside the body according to size and strength with ropes and cables to control the large neck. This time we worked more like dancers participating in the wave of choreography. I stayed on to become part of a smaller crew working the movements of the Dictabird. I was in charge of the remote control eyes, part of my standard puppeteer vocabulary. I was also cast as one of the puppeteers for Dino, the family pet. The day before rehearsals started many of our cast and crew went to the opening of *Jurassic Park*, which was the first film to employ computer generated imagery (CGI) on a large scale. We all knew it was a historic moment. The next day when we looked at the call sheet, we learned that the puppet had been replaced with CGI.

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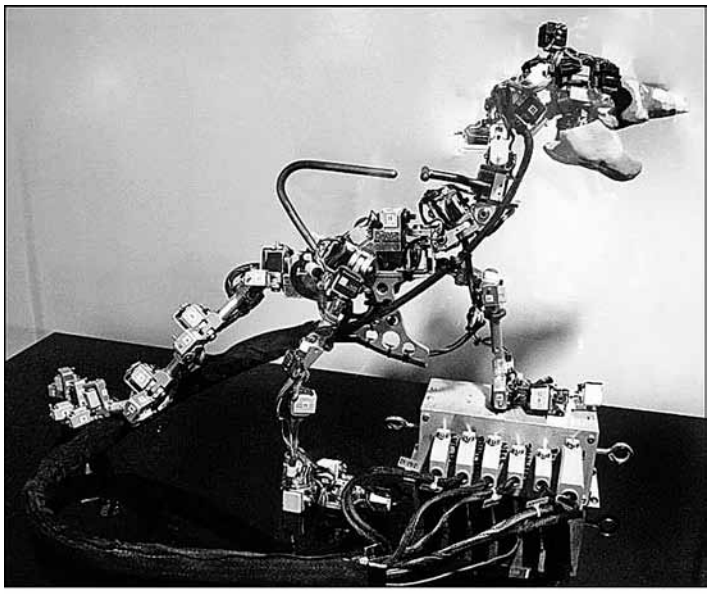


Digital Input Device used in Jurassic Park, Craig Hayes, Rick Sayre, Brian Knep, Tom Willams

Phil Tippett Studios pioneered the prototypes for *Jurassic Park* back in 1988 by converting armatures built for stop-motion animation and transferred their movements into a computer. Joint movement was read and measured by rotary potentiometers, animating computer-generated dinosaurs. These 'Digital Input Devices' - DID's revolutionized the industry once again. (http://www.blep.com/rd/special-effects/dinosaur-input-device/)

Who Framed Roger Rabbit

In 1996 I was involved with another new technique used in *Who Framed Roger Rabbit*. My job was to manipulate objects such as the dancing brooms in real time. The puppeteers worked with a choreographer and moved the brooms to music. The animation crew then painted out the puppeteers and used the footage as a road map for executing the two dimensional cartoon brooms that appeared on screen.

Shrek

That same year I was on the cutting edge of another major transformation. I was one of a few puppeteers hired by DreamWorks to experiment with motion-capture techniques for the first *Shrek* movie. The project literally began in Tim Lawrence's garage in North Hollywood. The idea was to combine motion-capture, key-frame animation, puppetry and sculpted facial expressions digitized into the computer. Tim and Loren Soman fashioned uncovered articulated puppets based on the character illustrations DreamWorks provided. Each figure had several reflective spheres carefully imbedded into the joints and extremities. Once in the studio, we were surrounded by cameras, each tracking the movements of the balls from their unique vantage point. The multiple feeds were sorted and analyzed by a master computer, which used the information to animate the two-dimensional figures on the computer screen. In this case, our live performance was a digital input device that was read optically by the cameras.

Digital Puppetry and Virtual Theatre (Section by Jeff Jacobson)

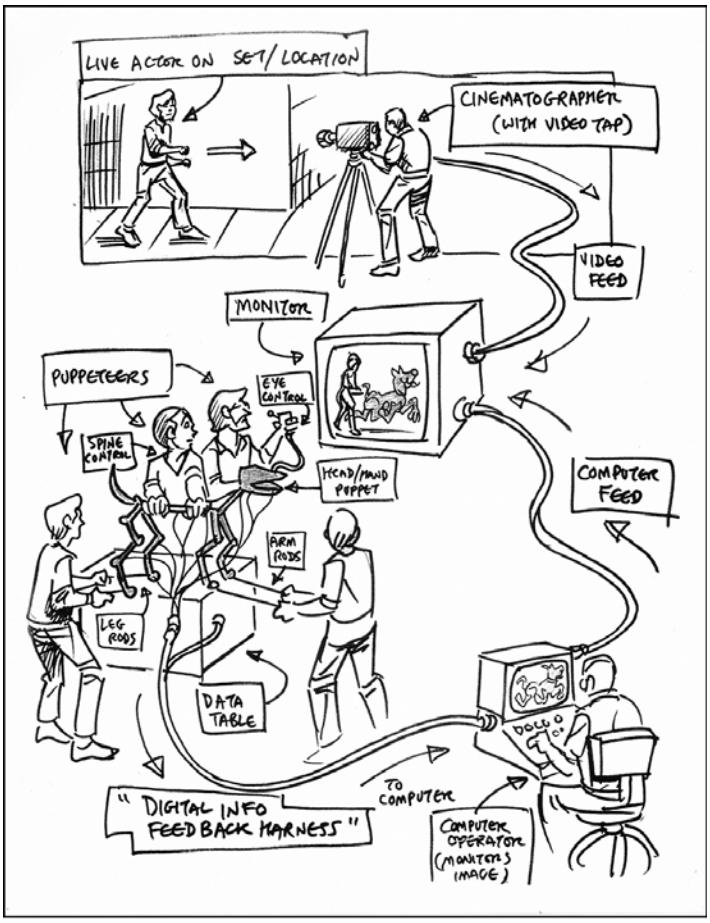


Illustration by Pete Von Sholly

Today, many of the puppets used in film are digital. Highly realistic or lifelike digital puppets, such as Gollum from the *Lord of the Rings* (Allison, 2011), are driven by live motion capture of an entire human figure, similar to the puppet experiments we did for *Shrek*. For Gollum, the actor's movements were directly translated to the virtual body, which was digitally captured and merged with the live footage. The humanoid effect is perfect for detailed anthropomorphic figures.

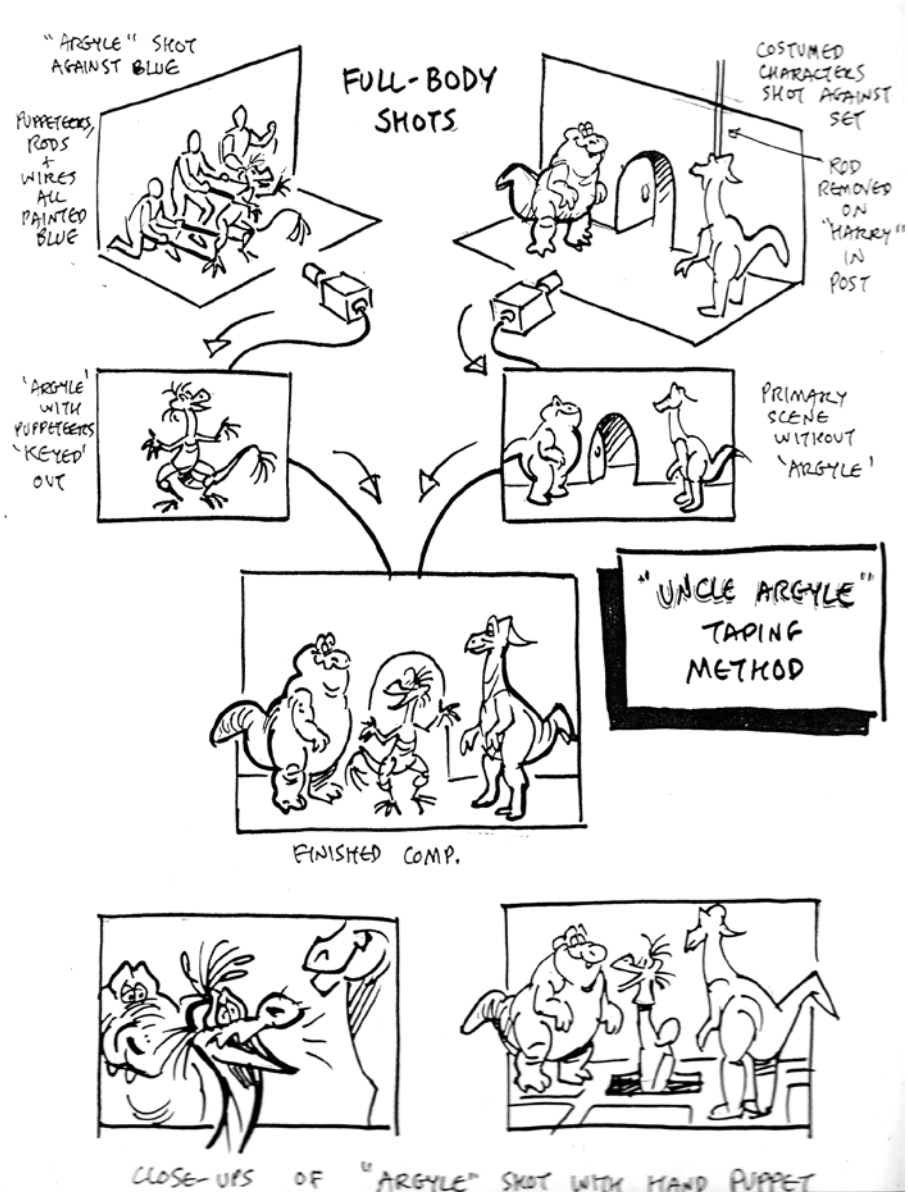
However, it is not the ultimate control interface for less human characters. The Henson Company and others use more abstract control mechanisms to amplify the power of caricature. They want to deliberately exaggerate or abstract puppet motions to achieve dramatic effect in a way that would not be efficient or possible with full-body motion capture.

In recent years, the game industry has provided a host of online virtual environments, where each player controls a new kind of digital puppet - an avatar. Most avatars are very primitive puppets. They are controlled through a keyboard and mouse and have a very limited range of expression. Depending on the structure of the game, the avatars interact with each other, with artificially intelligent "bots," the virtual environment itself, and the narrative generally. The most famous example is *World of Warcraft*, but there are many other of these Massively Multiple Online Role Playing Games (MMORPG) and a host of acronyms to describe them.

However, a small number of dramatic productions have used a sophisticated avatar/puppet. Ryu (2005) and her digital puppet performed a shamanistic drama for a live audience. Andreadis and his colleagues (2010) created a live performance by avatars/puppets in a virtual *Pompeii*, which was projected onto a large screen for a live audience. Anstey et al (2009) staged a number of dramas with a mixture of virtual and live actors.

A recent virtual collaboration from the Boston area, the Egyptian Oracle Project (http://publicvr.org/html/pro_oracle.html), used a more versatile Xbox 360 controller. The control contour is reminiscent of those used to operate facial expression during the preceding decades. It is an interactive performance, where audience members may communicate directly with the puppet controlled by Brad Shur.

In a cultural sensitivity training scenario employing the Gepetto system (Mapes, 2011), a trainer-puppeteer controls virtual Arabs with a single user/audience member. In the *TeachMe*™ system, used to help middle school children resist peer pressure, a single puppeteer controls five virtual characters, who interact directly with the user/audience (Wirth, 2011). Similar work is being done with artificially intelligent (AI) human figures that interact with the audience/user. These are neither puppets nor avatars, but agents or bots.



In Conclusion

However a puppet is made to move – with a hand inside it, or strings, or rods, or cables, or levers, or electronic circuitry controlling its parts, or a human being inside a motion-capture suit programming a computer – the common denominator is the puppeteer, that skilled human being who knows just how to move the figures to create the illusion of character, personality, and emotion – to understand who the character is, what the character needs to do, and what emotions the character needs to convey. And, by the way, also become the master of the sometimes-complex technology to accomplish that movement.

Lisa Aimee Sturz creates puppets and performances for Opera, theatre, film, television, schools, libraries, and special events. Feature film credits include Howard the Duck, Ninja Turtles III, RoboCop 2, the Flintstones, Elmo in Grouchland, Muppets in Space, Batman Returns. Television appearances include Animal Crack-ups, Puzzle Place, Comedy Central and Murphy Brown. She lives in Asheville North Carolina and is the Artistic Director of the national touring company, Red Herring Puppets.

CONTRIBUTORS

Tim Lawrence worked as a studio artist for Rick Baker, ILM and Stan Winston and as a character designer for Dreamworks, Warner Bros., Sony, Amblin and others. He has performed as a Thriller zombie, and as puppeteer for Starman's Star Baby, Harry & the Henderson's bigfoot face, a Ghostbusters Terror Dog, Nunzio Scoleri in Ghostbusters 2, Caddyshack 2's gopher, McDonald's Mr. Potato Head, Gremlins 2's Mohawk, Apocalypto's howler monkeys and many more.

Jeffrey Jacobson, Ph.D. is a longtime researcher and author in virtual reality and serious games for education. His background is in information and science and human cognition, and his favorite topics are cultural history and stagecraft.

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SPECIAL THANKS

Eric Allard, Brian Knep, Wendy Morton, Kirk Thatcher, Mark Bryon Wilson