Las Absurdas Maquinas: Robotics, Art, and the Absurd

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Abstract

Las Absurdas Maquinas (The Absurd Machines) is an ongoing project to develop sophisticated robotic art installations that explore issues of form, movement, and the embodiment of the human experience. The robot Dirty Red, on view at the AAAI-01 robot exhibition, is a central component of this work. We present in this paper the technical details of the robot, as well as the motivation of the project in general.

1 Introduction

“Art,” Aristotle said, “completes what nature cannot bring to a finish. The artist gives us knowledge of nature’s unrealized ends.” [Clark, 1952]. Robotics holds a unique potential in the development of Western art. As roboticists and artificial intelligence researchers, we are engaged in a classic struggle to emulate and understand nature. Our lofty ambitions aim to embody the natural world around us in machines of our own design. We are completing what nature could not bring to a finish. In this aspect, we are both artists and scientists. Art, if it manages to escape trivial abstractions and pedantic formalism, has the capacity to say something profound about the human condition, the human experience, and the world around us. This, in a grand sense, is what we are doing in our respective research labs.

Las Absurdas Maquinas (The Absurd Machines) is an ongoing robotic performance art. It is an independent project currently being developed under the auspices of the MIT Artificial Intelligence Laboratory.

As part of the AAAI-01 conference, we have on exhibition a component of Las Absurdas Maquinas. This exhibition includes the robot Dirty Red and parts of the robot’s environmental installation. The robotic component of this sculpture is a tensegrity serpentine spine, based on NASA’s designs for a space crane, under force-fields control.

A primary focus of our work is exploring the integration of machines with evolutionary based form, movement, interaction, and intelligence. The goal of this work is the creation of a new sculptural language of mechanical art. This is an inherently classical concern, utilizing robotics as an enabling technology.

As artists, our work deals with the most fundamental aspect of the artistic endeavor: the human condition embedded within a sociopsychological framework. We use robotic sculptures to enact these issues. In the same way that the industrial robotic arm can embody a worker’s toil, robotic sculpture can symbolize the human dilemma.

Las Absurdas Maquinas is based in part on the influential etchings, The Disparates and The Disasters of War, by the Spanish artist Francisco de Goya. Goya’s etchings capture both the basest aspect of the human struggle and the appropriation of the absurd as a reconciliatory mechanism within the mind. Las Absurdas Maquinas aims to immerse the viewer in the spectacle and manifestation of Goya’s work.

As roboticists, our work provides a physical application to current research underway in the Humanoid Robotics Group at MIT. Our hope is that in applying techniques developed for robotic active vision and motor control, we can create robotic sculpture which conveys a sense of animacy and engagement with the world.
2 Background

Robotic sculpture dates back to the ancient Greeks. In fact, the earliest robots were conceived for entertainment purposes. Hero of Alexandria (c. 85AD) wrote a treatise entitled “On Automatic Theaters, On Pneumatics, and On Mechanics” in which he described a number of small hydraulic powered statues, including a robotic reenactment of Hercules slaying a dragon. These first robots were entertainment devices by necessity. In a striking parallel to the state of modern robotics, robots of ancient Greece were only socioeconomically viable in an animatronic form [Rosheim, 1994]. Later, Leonardo da Vinci would pursue the work of Hero of Alexandria. Da Vinci, it is purported, constructed a mechanical lion which would walk across the stage and, opening its chest, deliver a bouquet of flowers to the king of France, Francis I.

These early robots were a wonderful mix of artistry and technological advancement. They were bound by dreams of replicating human and animal forms in machines. At the core of this early work we find the long-standing urge to recreate reality through our own means, for man to recreate himself through technological devices. We can find this drive towards realism throughout the history of Western art. As modern robotics researchers, we are extending a well developed history of artistic realism. Robotics and artificial intelligence add a unique component to this history. As we develop cognitive architectures and models of intelligence, and embody them in our robots, the reality we seek to replicate becomes much more profound than the surface reality pursued by the Greeks.

The modern conception of robotic art began with the Russian artist Naum Gabo and his sculpture Kinetic Construction (Standing Wave, 1920). More significantly, the work of Swiss sculptor Jean Tinguely defined a strong formal language of industrial machinery merged with kinetic movement (Figure 2). Much of the current sculptural aesthetic of robotic art harkens back to Tinguely’s work. “Life is movement”, Tinguely has said. “Everything transforms itself, everything modifies itself ceaselessly, and to try to stop it... seems to me a mockery of the intensity of life.” [Violand-Hobi, 1997]

These pioneers of modern robotic art were foremost concerned with the movement of the sculpture. After thousands of years of predominantly static statuary, sculpture finally seemed to come alive.

Survival Research Laboratories (SRL) [Pauline, 2001], headed by artist Mark Pauline, has defined much of the current mode of robotic performance art. Over the last twenty years, SRL has put on numerous live performances. According to SRL, each performance consists of a unique set of ritualized interactions between machines, robots, and special effects devices, employed in developing themes of socio-political satire.

Las Absurdas Maquinas grew out of work done with another robotic performance group, the Omnicircus [Garvey et al., 2001]. The Omnicircus group incorporates robotic performers with music, video, and theater to form a high-tech industrial-surrealist art installation. A seminal work by this group is the robot One Legged Men at a Butt Kicking Contest (Figure 3).

3 Technical Details

The robot Dirty Red (Figure 1) is a principal sculpture in the Las Absurdas Maquinas project. In its latest incarnation, Dirty Red has four degrees of freedom (DOF), including: a one DOF body pan, a one DOF crossed four-bar linkage arm (Figure 5), and a two DOF tensegrity spine (Figure 4). All actuators are 24V DC motors, using either encoders or potentiometers for position feedback. Dirty Red also utilizes a single CCD camera for visual feedback (not present in the exhibition). Position and velocity control is maintained on the robot using a daisy-chained RS-485 network of PIC based motor control cards. A Windows based host laptop performs supervisory control and perceptual computations.

The tensegrity spine design has a lineage going as far back as Da Vinci’s drawings for winged flight mechanisms. More recently, the work of Shigeo Hirose [Hirose, 1993] has explored similar serpentine robots. The spine used in Dirty Red is derived from NASA’s design for the Space Crane [Rosheim, 1994]. Functionally, the tensegrity spine is four universal joints stacked in series (Figure 6). Including the
Figure 4: The tensegrity spine of Dirty Red

Figure 5: The crossed four-bar linkage arm and cable drive mechanism of Dirty Red.

Figure 6: A tensegrity spine joint.

\[ \dot{V} = \frac{1}{\alpha \sqrt{2\pi}} e^{-\frac{\alpha \beta^2}{2}} \times m \times d \]  

where \( d \) is the error in position, \( m \) is the range of the velocity field, and \( \alpha \) is the power of the velocity field.

We are actively exploring perceptual systems for Dirty Red to enhance the animacy and interactivity of the robot. One such system currently under development, is an active vision system that will allow the robot to interact dynamically with the viewer. We have drawn from work on the MIT robots, Cog and Kismet [Brezeal, 2000; Brooks et al., 1998], for insight into developing a cognitive architecture for Dirty Red. One component developed for this work is a human eye-tracking subsystem [Brezeal et al., 2000]. This perceptual ability will allow the robot to engage the viewer by roughly directing its actions towards the viewer.

4 Las Absurdas Maquinas

Las Absurdas Maquinas encompasses an ambitious endeavor to manifest the primal and social forces of the human psyche in a multimedia robotic installation. Robotic performance art holds a unique potential to represent the complexities of the human experience in a robotic form. In their early Greek conception, robots were liturgical tools and entertainment devices. The modern conception of the robot has shifted to that of a machine designed to assist humans in tedious tasks. Las Absurdas Maquinas returns to the original Greek inspiration. We hope to utilize modern day robotics to create synthetic characters which can exist as symbols of the human dilemma.

The symbolic embodiment of the robot is illustrated by the advent of the industrial robot arm towards the end of the last century. Even though the inception of the industrial robot was driven by an economic, and not artistic impetus, the factory robot has the assumed the stature of a symbol. Designed to remove the worker from the drudgery of menial tasks, this robot has come to represent the victory of technology over toil. The industrial robot arm has assumed the role of Sisyphus, the Greek tragic figure condemned to rolling a boulder up a hill for eternity.
We can see this idea again in a robotic panhandler sculpture named Go-Boy by artist Frank Garvey [Garvey et al., 2001]. Garvey took the robot to the streets to panhandle from pedestrians. Onlookers were confronted with a beggar which, though mechanized, still elicited the complexity of emotions often experienced with the homeless. However, because Go-Boy is simply a machine not an actual human, the social niceties often fall away when interacting with the robot. Actual dialogue, directed at the robot, includes: “That is wrong”, “It is ugly, people don’t want to see that”, and “I’d like to see the first robotic panhandler get arrested.” Go-Boy demonstrated the potential for robotic works to magnify social stresses and embody components of the human experience.

As we build robots to exhibit many of the deeper complexities of the human psyche, they can become symbols of human capacity and embodiments of our struggles, thoughts, and emotions. This is the direction that the Las Absurdas Maquinas project is working towards.

References