INTERACTIVITY AND CONTROL

THE AESTHETICS OF REAL SPACE INTERACTIVES

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The formation of limestone or petroleum from biological deposits has long been understood, but the extensive relationship between the biological and geological is jus beginning to be sketched out. The recent discovery that, in the US, humanity has become the dominant geological force is significant. Our combined activities alter more of the earth's crus than weathering, erosion and the activity of rivers.

Having been ejected from the Garden of Eden for the development of consciousness we have always seen ourselves as apar from it. The categories of 'the Natural' and 'the Artificial' are ancient and fundamental to the cultures within which I and many of you exist. The intricate assembly of a beaver's dam and lodge are understood to be of nature whereas the autobahn and Brazili are clearly not. Yet, if we suspend the egocentrism for a moment we can see that these are differences in degree rather than of kind All the products of human activity are 'natural' ones.

There is no artificial. Machines are part of the ecosystem.

The development of computation machinery in the last hal of the twentieth century is one of the primary developments during this period. Shrinking from room-size constructions to handheld devices - they are posed to disappear into the woodwork. This migration fundamentally changes the nature of the environments that we inhabit. There is an erosion of inertness by the injection of intelligence. We must begin to consider the role we are to play within the context of intelligent environments

This work is concerned with issues in technology where the inability to control is at the heart of the matter. The projec exhibits behaviors that are determined jointly by the interna logic of the software, the participation of the viewer(s), and by environmental circumstances. The work does not relinquisl control to either the public, the environment, or the software but sets up a condition where the confluence of the three result in a particular behavior. It uses rather simple technologies to explore issues that are raised by the larger contemporary technical environment in which we find ourselves.

The work consists of two rectangular boxes from whicl project 24 black tapering rods. Ones presence between the boxe

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triggers an adjacent rod into a slow graceful bend. The motion is fluid and completely silent. Others soon follow, arching foreword or to one side and then the other. After you move on, the activity continues and it becomes clear that the rods were not reacting to you, but that the reaction of the initial rod was spreading through the population in a series of ripples - that the rods are reacting to each other. The intent is to create a work that is simultaneously machine, plant and social insect.

Each of the rods are tensed by two fine strands of Shape Memory Alloy (SMA) wire. SMAs are a class of alloys that exhibit an unusual effect due to differences in the crystalline structure of their martensitic and austenitic phases. When cool, the metal is easily deformed, but when heated above the transition temperature to the austenite phase, it recovers its original shape and in the process is capable of work[1]. The wire used in this project is fabricated from a nickel/titanium alloy marketed under the trade name Flexinol. It is 150um in diameter and has a deformation force of 62g and produces approximately 330g of recovery force[2]. Each strand of SMA wire is 1.5M long and recovers approximately 60mm when resistance heated with 24 VDC.

While current research is concerned with increasing the reaction time of the alloy for use as robotic actuators, in this case, the wire length was chosen beyond the suppliers specifications to decrease the response rate for aesthetic effect. This had additional benefits. As there was no danger of overheating, the temperature of the wire did not have to be monitored. A streamlining of the sensing and control functions resulted. More significantly, because the mass of the SMA strand is very small, the nature of its reaction varies with ambient temperature and wind conditions. Wind cools the SMA rapidly. While the work responds more quickly and strongly in hot weather, in winter, it will not react at all[3].

The tapered rods are fabricated from a graphite/epoxy composite[4] and provide sufficient bias force to stretch the SMA in its low temperature state. The hollow rods serve as a conduit for wiring that supplies power and ground connections to the SMA wires that are fastened to the black acrylic brackets secured to the rods. The lower bracket holds the wires out away from the axis of the rod and provides a reverse bias mechanism[5] as the alloy contracts and the rod is loaded eccentrically. The two wires provide four possible states for each rod.

Each rod constitutes a finite state machine implemented in hardware and assumes a position based on the state of the surrounding rods or the switches in a manner similar to cellular automata. No attempt has been made to program the activity of the rods as a group, but relationships between them are established and the group's activity emerges from the individual interactions.

In software, each SMA wire is controlled by a variable. The value of this variable is determined by simple rules that reference the state of 'adjacent' variables to compute its new state. Adjacency is specified relative to the irregular spatial distribution of the rods rather than by reference to a uniform lattice. The states are computed and then implemented in discrete time steps.

Each base contains a computer that was assembled from modular input, output and processor cards in a proprietary backplane[6]. The processor is an 8-bit Intel 8052AH. Programming was done Basic. The code was converted to C and implemented with a corresponding graphics display running on a Silicon Graphics workstation to verify the software and visualize the sequences[7] while the project was under construction.

The bases are simple plywood boxes that are covered in a resin/aluminum powder product that is used for the repair of boat hulls. This material was ground smooth and waxed to give the bases a metallic monolithic quality[8].

The work undertaken here draws on research done in preparation for a Seminar in Technology Transfer given by the author at the Graduate School of Architecture, Planning and Preservation at Columbia University. This course looks at technologies that are available or developing in non-architectural fields that have potential applications within architecture. Among the areas considered are intelligent materials and structures, robotics, complexity studies, and computation. The underlying thesis is that the importation of these technologies into architecture will fundamentally change the definition of the architectural problem. The task may be redefined as the creation of environments that are casually indistinguishable from biological systems. The current project is an initial exploration of what those environments will become.

The objective in undertaking work such as this is to understand on an empirical level the nature of non-deterministic design. As intelligence, even at a very basic level, is diffused into the environment, as communication between these intelligences is implemented, and as the materials or assemblies become responsive to their environments, we can expect that the resulting behaviors will be inherently nonlinear and predictable only within certain broad ranges.

Yet the words design and non-deterministic do not sit comfortably together. Design implies that there is an objective to the work. Someone is able to project an understanding, an implicit ideology of how things ought to be , upon the world or some portion of it. Not only will this be increasingly difficult, it may, in fact, not be desirable. This imposition of will or the desire to control is linked to our understanding of ourselves and our products as somehow apart from the rest of the world. It grows out of a privileged position that we do not occupy.

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Notes

[1]R. Gilbertson, Working with Shape Memory Wires, Mondotronics, Inc. , 1991
[2]Mondotronics Product Literature, undated
[3]K. Kuribayashi's Improvement of the response of an SMA Actuator using a Temperature Sensor, The International Journal of Robotics Research Vol. 10, No.1, Feb 1994. The work was commissioned by the Katonah Museum in Westchester County, New York for the exhibition 'Shelter and Dreams' curated by Jane Dodds. The exhibition, in an outdoor sculpture garden, opened on April 22 and remained in place until November 13, 1994. The expected temperature variation during this period was one of the design considerations.
[4]These were purchased off-the-shelf from a fishing rod manufacturer.
[5]Gilbertson
[6]Alpha Products, Inc.Us A-Bus System
[7]Lyle Seuss, a graduate student at the GSAPP, Columbia University was responsible for the simulation. Additional programming assistance was provided by Paul Krueger.
[8]Much of the construction and assembly was undertaken by Bill Massie of Sub Urban Building Studio of New York assisted by Corey Saft and Scott Enge.. Jean Krueger provided assistance and support over the duration of the project.