

# Experiments with Reactive Robotic Sound Sculptures.

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## Abstract

This paper describes two robotic sound sculptures produced in collaboration with Danish artist Tine Bech. ‘*Echidna*’ and ‘*Boundless in Space*’. The sculptures were exhibited at the Aarhus Kunstbygning gallery in Aarhus, Denmark from the 3<sup>rd</sup> to the 25<sup>th</sup> August 2002. I will describe the sculptures and also defend the use of simple reactive robotics in interactive art.

## Introduction:

After exhibiting my interactive sound installation “The Sound Gallery”(see [1]) in Brighton, England, I was approached by artist Tine Bech who was excited by the idea of using robotics and artificial life techniques to add interactivity to her sculptures.

Tine explained to me how after having studied large scale land art pieces such as the Rodden Crater project by James Turrell [2] she had come to realize that art is something that should be experienced not only visually and intellectually, but with the whole body and with all the senses. As Merleu-Ponty wrote, “Our understandings of space emerge from action, indeed space is to be defined as a ‘certain possession of the world by my body’”[3]. The massive scale of land-art pieces in relation to the body force the perceiver to experience the work with the whole body through the medium of action. And through this means of interaction, the perceiver gains a greater sense and understanding of not only the given environment, but also of the nature of his own body and its sensory apparatus too.

Robotic and artificial life sculptures encourage people to interact in a more somatic and tactile way without resorting to the extremities of scale of the land artists. By building motion and proximity sensors and sound and motion actuators into the sculptures we were able to make the artworks respond to bodily interactions with sound and movement. This amounts to an invitation to play with the sculptures in a physical mode that goes beyond a purely intellectualised appreciation.

## Description of the pieces

The two pieces that we produced for the exhibition were entitled ‘*Boundless in Space*’ and ‘*Echidna*’. Both pieces consist of a sculptural form built by Tine augmented with some simple electronics built by me. *Boundless in Space*, with its textured organic surface made from uncooked tapioca pearls, looks like a creature that could have emerged from some dark uncharted sea. Its surface is studded with small semi-spherical growths that could conceivably be interpreted as the wart like manifestations of some alien disease, as an excessive multitude of non-mammalian mammilla, as parasites or as progenic fungal spores. Whatever they may be, several are not attached to the main body of the sculpture and take their chances alone, isolated on the gallery floor and at the mercy of blundering feet.

Eight ultrasonic proximity sensors are mounted around the sides of the sculpture, which is powered by an electric motor from a car windscreen wiper. If over-zealous spectators get too close it will attempt to scuttle away whilst its multiple relay switches click maniacally.



**Figure 1** Interacting with *Boundless in Space*

*Boundless in Space* is also equipped with a small radio transmitter that allows it to communicate with the trail of independent growths, some of which may vibrate in

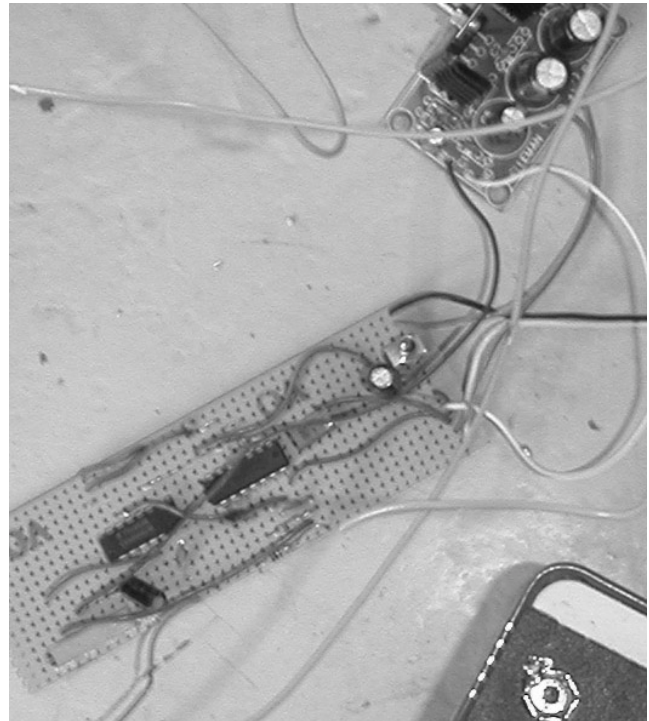
sympathy or anger when its personal space is invaded. The control circuitry for *Boundless in Space* is very simple, having more in common with simple Braitenberg Vehicle [4] style robots than with more complex artificial life paradigms. Logic gates are used to determine the direction in which the motor should be activated according to which sensors are stimulated. Yet despite the simplicity of its control circuitry, *Boundless* appears to display complex autonomous behavior. If approached by an observer it will attempt to withdraw, as if trying to flee from a perceived predator. If approached by several people from more than one side, *Boundless* jitters indecisively, as if unsure of which way to turn. These movements are accompanied by sharp rhythmic clicking sounds that in fact originate from the multiple relays switches inside the robot, but that resemble panicked warning signals or pleas for help.

'*Echidna*' is another name for the Spiny Anteater, a porcupine like creature that may be able to sense electromagnetic fields [5]. *Echidna's* body is made from a tangle of wire. It sits on top of a small plinth inside of which are hidden the electronics, a very simple circuit based around a phased-locked loop chip. *Echidna's* entire body acts as an antenna that picks up variations in the electromagnetic field around the sculpture caused by the proximity of people. These variations are converted to sound, giving *Echidna* a voice.



**Figure 2 Echidna**

Despite its simplicity, *Echidna* exhibited a large range of interesting sonic behaviours. This behaviour reflects not the sophistication of the underlying electronics, but the complexity of the environment in which the sculpture is situated.



**Figure 3 Echidna's electronics.**

#### **Low tech versus high tech**

The artist Ken Rinaldo is one of the most well known exponents of A-life influenced robotic sound art. In one paper he imagines an ideal of this kind of robotic art as "a cybernetic ballet of experience, with the computer/machine and viewer/participant involved in a grand dance of one sensing and responding to the other...[allowing] new sculptural and virtual algorithmic manifestations which will far surpass our wildest imaginations"[6]. It is assumed that such a scenario would entail very sophisticated robotics and artificial intelligence programming. In a forthcoming paper, Bird et al argue that only 'epistemically autonomous' robots capable of dynamically creating new mappings between sensors and actuators and of constructing their own sensors could fulfill Rinaldo's vision. [7] In fact we found that using only simple electronics we were able to create interactive artworks that inspired a great deal of curiosity and interest through their ability to respond with a surprising diversity of sound and movement to intuitive interaction.

Rinaldo's writes that "Artificial Life techniques...present opportunities for both artists and viewer/participants to develop true relationships with the computer that go beyond the hackneyed replicable paths of "interactivity" which have thus far been presented by the arts

community.” He further claims that “The word interactivity is often overplayed perhaps because it demonstrates a kind of technical seduction although there may not be a deeper aesthetic realization. In other words, finding a real poetry of interactive form and content is reliant upon simple button activation”[7]. Is this an argument against the effectiveness of simple reactive robotic systems in art? Rinaldo seems to be implying that simple robotic systems are only interactive in a trivial and repetitive way. But reactive robots often behave in ways that belie their apparent simplicity. Edward Ihnatowicz’s ‘Senster’ robot, created in 1969, was controlled by a 12-bit Honeywell computer with only 4K of memory. However, Paul Brown tells us that “Behavioural scientist queued up to do experiments with the system and couldn’t believe that something so simple could produce behaviour so lifelike”[8].

In cases like this, the complexity often arises not from the machine, but from the environment in which it is situated. The first requirement for more than ‘button interactivity’ is environmental sensors sensitive enough to pick up and respond to the complexity of the environment it is in. A button is a very impoverished input device, allowing a machine to respond to only two external system states, i.e.: *on* and *off*. By using analog sensors a much greater diversity of behaviour is made immediately possible. The simple electrometer/theremin-like sound sculpture I built with Tine exhibited complex sonic behaviour in the gallery. Tickling it seemed to have an entirely different effect from pushing on it firmly and sometimes invisible spikes in the electromagnetic field would cause unpredictable yelps of different pitches

*Boundless in Space*’s jittery, nervous behaviour is also partly attributable to the ‘noisiness’ of its cheap ultrasonic proximity sensors. A push button is always on when you press it and off when you don’t. Less reliable sensors lead to a less predictable response.

It is interesting to note that people, especially children, immediately knew how to play with the sculptures and took to them with intuitive delight. This is not always the case with more complex adaptive pieces. Such pieces often leave people confused as they find it hard to correlate their activity with that of the machine and this can be a barrier to their appreciation of the work. It may be that they find they have a cybernetic ballet partner who doesn’t feel like dancing. Rinaldo raises this point when he claims that “One difficulty with some Artificial Life artworks is that the systems may not seem to be responsive to the changing environment, as the work demonstrates its own internal desires. This can make the work seem unresponsive or uncaring”[6].

Nielson recently wrote about the issue of good usability in physical interaction (as opposed to virtual interactions with screen based GUIs). He says: “we’re simply replacing

one form of syntax with another that has more degrees of freedom. And more choice for interaction design means more ways to make things difficult for users.”[9]. It seems strange to worry about the ‘usability’ of art. But it seems to me that intuitiveness of interaction is probably a prerequisite for any true fulfillment of Rinaldo’s vision. To conclude, while the future may bring us sophisticated Artificial Life artworks capable of astonishing us with unimaginable novelty, we should not forget that humble reactive robotic systems capable of sensing and reflecting the complexity of their environments have the capacity for unpredictable and life like behaviour that encourages playful somatic interaction.



**Figure 4 constructing boundless in space**

#### References:

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