chaos cube — interactive model worlds
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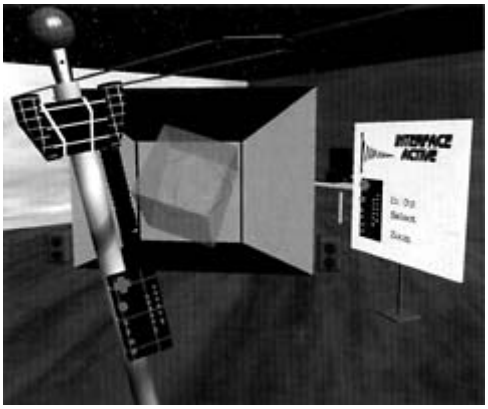

Historical Connections

Our philosophical and scientific exposition with model worlds seems to be as old as mankind thinking about views of life. Our ancestors dealt with the unintelligibility of the cosmos and the inconceivability of nature by inventing a variety of deities. For the western cultures the Greeks added philosophical experiences about nature to the mythologies of creation. According to Anaxagoras [1], the first deities of the Greek mythology, Gaia and Eros arose from CAOS -the tohuwabohu or chaos without any structure initiated by the NOUS -the spirit understood as the only non-miscible entity — by a process he called "perichoresis" — developing structures by a reverse mixing operation. Plato's image of the cave, where he compares the problem of understanding nature to the problem of a human observer interpreting projections of reality,[2] still documents our dilemma with any theory of cognition. Our modern scientific views of the cosmos are founded on the discussions of the mechanical epoch about the image of the clockwork universe. Though modern physical theories -like the theory of relativity and quantum mechanics have liberated us from the idea of absolute space-time and the observer independency of the physical universe, we still believe with Pythagoras and Galilei that "the number is the character and essence of reality". The language for understanding nature is the mathematically formalized theory of physics.[3] In that sense nature may be deterministically calculable and mathematically understandable. Our actual understanding of reality is significantly influenced by the virtual realities of the computer age.[4] Though the first and most original descriptions of virtual worlds can be found in science fiction literature, such as "Simulacron III" [5,6] the concept is very well-known in the natural sciences. The foundation of classical sciences is the idealization of natural processes with simulated model worlds. Einstein handled them as "Gedanken"-experiments; today our model

worlds can be numerically simulated with computers. The Chaos Cube is a computer-graphical interactive installation. It is an experiment for the theory of cognition. Using an example of a pure abstract mathematical model world it illustrates the problems of dealing with "intelligent ambiences". The installation does not concentrate on real time photorealism for I believe the main challenge is the understanding of novel scenarios.

Mathematical Model World

The Chaos Cube allows for an interactive i.e. visual immersion in the virtual world of the so-called Chaotic Hierarchies.[7] These are time-continuous and time-discrete mathematical equations which simulate all kinds of nonlinear dynamics. The chaotic hierarchy uses the concept of hierarchical mathematical systems. The Chaos Cube can handle from two to four embedding dimensions. For observation, the dynamic states, which are the solutions of the mathematical equations depending on the initial conditions, are projected as sets of points or trajectories of the attractors. Different dynamic states correlate with significant geometrical structures.

Simple periodical and therefore regular dynamics will give finite sets of points or closed orbits. Chaotic states show complex clouds of points or non-repetitive line structures.

Interactive Manipulations

On the highest level of interaction the user chooses the model system from time-discrete iterative maps or time-continuous differential equations and chooses the dimension of the model between two to four degrees of freedom. With the help of a cursor he walks around a two-dimensional parameter plane and selects the parameter values. The coloring of the parameter plane and the projections of the attractors on the sidewalls of the Chaos Cube help with the differentiation. The dynamic solutions according to the chosen state can be seen as floating stereographical projections. These global views of the attractors may be freely rotated and zoomed in. The idea of Endo-space science[1] postulates the fascinating opportunity to change our position of observation to the objects of interest to gain new insight of our world. With the Chaos Cube it becomes possible to view the local object world from an inside view. Dynamic systems may be visualized from the local space of Eigenvectors. The Chaos Cube can simulate a point of observation right on the trajectories of the system, i.e. right on the flow evolving in time. The observer finds himself within a local volume of space following the trajectory. The forces acting upon the local environment continuously deform it. The observer experiences the time-dependent and structural evolution of the system on site.

Manipulator Interface

The interactive control of the Chaos Cube is realized with a novel manipulator. The interface is a crotch the user carries around. The manipulator is fitted with a small keyboard and a microphone for controlling the system with a simple command language. The position of the manipulator in the space in front of the projection screen is tracked with an ultrasonic device. This allows for the location of the position on the virtual parameter plane and an observer centered geometrical projection of the objects. The active system parameters, some control commands and online help for system control, will be displayed on an additional screen.

LITERATURE

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