



Excerpt of an interview with Brian Reynolds of Ohio State University for documentation of the "Meta M Hyper Culture" symposium held at the Wexner Center in Columbus Ohio in February 2002.

Brian: First, could you tell me a little bit about what you do and how you became interested in this work? Also, how do you see your work and research impacting your own practice and the field in general?

Michael: In a nutshell, the idea is to create spaces and objects that can physically re-configure themselves to meet changing needs. The central issues in making these types of systems are human and environmental interaction (the changes) embedded computational infrastructures (intelligence) and the physical control mechanisms (kinetics). In retrospect I came about these ideas in somewhat of an opposite way than one might expect today. I first became interested in kinetic solutions in architecture with a focus on looking at how such systems can facilitate adaptability. The kinetics then are generally either transformable objects that can dynamically occupy predefined physical space or moving physical objects that can share a common physical space to create adaptable spatial configurations. After exploring numerous kinetic projects with this focus on adaptability it became an obvious next step that such spaces and object should be coupled with some sort of brain that can allow them to reconfigure themselves. I say I came about this topic in a roundabout way because today there is a great interest in academia, and even the corporate and commercial sectors in intelligent environments. Everywhere we turn there is a smart house or smart office etc. etc. and so the obvious route would be to say that we have this space that is really smart, that understands the environment inside and outside and understands various data about the users including behavioral patterns but what is it doing? This is where I think the kinetics become important; to really extend the notion of *enhancing* everyday activities to creating spaces and objects that can *extend* everyday activities and do things that we cannot do or that are very difficult or inconvenient to do. In other words I like to think of the building as a body with bones and muscles and a brain that can control their behaviors, an intelligent environment without the kinetics is like a brain with a body that is incapable of moving and without the brain we can have of course the kinetics but no behaviors. When they are combined to what I call "intelligent kinetic systems" (IKS) they begin to have implications on the profession that are not negligible especially in terms of things like safety, security, spatial efficiency and energy efficiency (such as when coupled with traditional passive sustainable solutions).

Brian: Full scale kinetic architecture is one that embeds computational subsystems into a system capable of transformation through motion. This requires the architect to be fully engaged in the methods of fabrication as well as the programming of the computational subsystems. Does kinetic architecture suggest that architects respond with an equally kinetic process? Does this change the traditional role of the architect?

Michael: Also I think it is good to point out that nothing I am saying is really new to the field of architecture on a theoretical level but we are really at a point in the profession where such systems are possible and even feasible from an economic standpoint. Architects really need to take a more active role in directing the development of this area of design. To do this we need to have at least a superficial knowledge base of both the engineering in terms of mechanics and fabrication and also the computational substructures. It is typical for architectural students to take courses on structures and HVAC systems etc. that provide the superficial knowledge necessary for design. In professional practice specialists take on these roles. Architects then should also be taking courses on simple mechanics and computation in order to develop the skills necessary to explore, think about, and design intelligently responsive kinetic structures and systems. As architects we are not doing structural calculations on a building and we should not be programming so, in short, no the traditional role of the architect will not change, but we will have new roles of engineering and consultancy.

Brian: Many architects are finding that the increased access to CNC fabrication technologies is allowing them to realize their designs with increased efficiency as well as permitting them to realize designs that would otherwise be impossible or certainly too difficult to construct using traditional methods of construction. How do these technologies, which could be seen as forms of kinetic architecture themselves, influence your process of design?

Michael: I think that the importance of CNC relative to kinetic designs lies more in the design process rather than in terms of fabrication processes. Basically I think that what you are talking about is more referential to form-making. Ironically, CNC was invented in engineering to increase design and manufacturing process performance and was adopted by architects as being useful for presentation models and was considered inappropriate for early stages of design. Only later did architects come to understand that processes such as rapid prototyping could be useful in the design process. This is where I think CNC does have an influence in particular with the design of complex three-dimensional parts and parts that will be set to motion. I think that what CNC has recently afforded architects in terms of realizing (design-to-fabrication) forms is rather profound. Again this was basically adopted

from other fields of design (both product and aerospace I believe). Mechanical design also is extremely well developed both in terms of design and fabrication, and it is up to architects to adopt the processes.

Brian: CNC fabrication processes provide dimensional tolerances in material manipulation which are unattainable or at the very least unreasonable to be consistently expected by more traditional methods of fabrication. Does the nature of kinetic architecture require this increased precision?

Michael: This is really a continuation of the above question but I want to point out that it is important to see such systems in kinetic architecture as subsystems. A very smart building should mechanically adopt the paradigm of ubiquitous computing. The autonomous mechanics will prove important for making things that are robust in terms of failure. In getting to your question though, the idea of discrete mechanics has an effect on the dimensional tolerances. In other words the individual parts do have to be precise but not necessarily the larger building as a whole. Think of examples that already exist such as rotating sensor activated doors and escalators etc. These do need to be quite precise in their own operational way but not in terms of their tolerance with the larger architectural whole.

Brian: There is currently reluctance on the part of the automotive industry and the general public to accept “drive by wire” technologies which replace the direct mechanical link between the driver and vehicle with sophisticated sensor systems and a computational subsystem which processes input from the driver. The concern being that if a malfunction, either hardware or software, disrupts the flow of information, the result could be life-threatening. Traveling in a car at 90 mph and a kinetic architecture that responds to conditions of its surrounding environment do not have the same safety concerns, but it does suggest that systems that rely on embedded computational subsystems are only as good as the programs that are processing the information they receive. Could you discuss some of the challenges that face kinetic architecture from a reliability and dependability standpoint?

Michael: Well this is a very important question especially in terms of acceptance. The safety issues are really not comparable however and already have precedent in things like automatic garage doors etc that can be tackled with simple IR shields that detect obstacles in the path of motion. I think however the question of robustness is more important than that of safety. I have story of being in a car in Boston during a snowstorm with power windows that would not roll up. I was furious that there were no manual handles to roll up the windows. There should always be a manual means of controlling the motion or in cases of the objects being too large or heavy to manually move then there must be a means of egress considered such as in elevators. Also related to the notion of robustness is again that the intelligent kinetic systems should be considered discretely. If a rotating wall with a bed on it will not fold up for some reason, it will not prohibit other systems such as partition walls from sliding or rotating etc. In terms of large buildings an automated adaptive kinetic system could be very valuable in terms of energy efficiency as for instance coupled with HVAC systems. Where not only are rooms specifically heated or cooled that are being occupied but the doors and venting systems are physically controlled to manage the inefficiencies. If they are automated discretely, if one door does not close then they system of doors is still operational. In automotive terms, if the windshield wipers do not operate, you will still have headlights. Also I think that the automotive, aerospace and even maritime industries are far more developed in terms of being both intelligent and mechanical than that of architecture. Architecture is really in it's infancy from an application standpoint and there are many lessons to be learned. The point is we spend most of our lives in buildings and only use cars and airplanes to get from one building to another. I think the second most likely candidate for failure lies not in the computational subsystem (software) but rather in the sensing subsystem (from a hardware standpoint). If a system performs not as expected, it is more likely the result of clouded data input: something is blocking the sensor or providing conflicting data input. When I used to work late at night I would always notice the lights coming on and off in a neighboring office although no one was inside the office. The problem was that the professor had piles of loose papers that were constantly blowing around as a result of the automated ventilation system and the motion of the papers moving would turn on the lights. The remedy was to redirect the motion sensor to only look at the door but I think it is another good lesson.

Brian: From E.J. Marey's chronophotographic studies to the motion and efficiency studies of the Gilbreth's and numerous examples in modern art such as Duchamp's Nude Descending a Staircase, there has been and continues to be a history of exploration into how to describe and capture motion. In your elevator studies for the Porsche collector there is a cinematic nature to the motion of the doors that reminds one of the opening sequences of a James Bond film or to the aperture of a camera's lens. The responsive awning project traces the flows of passersby in a fluid wave-like description. Could you comment on the

inspirations or ambitions of these seemingly different types of motion description? What are the differences in the computational subsystems of these two projects?

Michael: I suppose that the conceptual link lies in the fact that they are both relative to motion in the part of a third party. In both of these cases it is the spatial conceptualizer (if we get academic). The point is that the motion in architecture is prescribed by a responsive and adaptive behavior. A layer on top of this might be a building shade that tracks the sunlight and also supplies shade relative to the spatial conceptualizer. The door studies were intentionally cinematic to be choreographed when the person drives in and exits. The studies were getting at a complexity that could be inherent in a very simple system. I am a bit disappointed with the end result of the elevator in the sense that it is too straightforward without the complexity/simplicity but it is a real project with a real client and that is a great thing. The saving grace is the layering of the wire mesh that still provides the illusion of complexity with the simplicity of four choreographed doors. The complexity then is really more visual than mechanical is the point. With the façade, I had already designed several responsive awnings prior to this project each dealing with many discrete parts that followed the motion of the pedestrians as they walked along the sidewalk below. This project was conceptualized with my partner Ran Oron when he had the idea of a sand dune on a particular building on 47th and Lexington in New York. The idea of many discrete parts then was translated to a scale where the individual parts become pixilated to the extent of having negligible entities. Upon prototyping and understanding how it would actually be constructed we came to the idea of individual points being articulated enough to be recognizable but still recognizable as a whole. With the help of Axel Killian we began studies in Java to find a motion that would be simple enough to make overall patterns with discrete elements and not lose the essence of the whole. In this project then the actual mechanics played a much more important role in the conceptual development. The computational subsystem is actually quite simple as a means to imbed certain robustness into the façade as a whole. The bars are in vertical strips of 10 both mechanically and computationally. Each vertical strip moves as a whole and only understands what it has sensed and the motion of its neighbor and its neighbor's neighbor on each side. In this sense if any one vertical strip malfunctions the system as a whole will still function and the vertical strip of 10 bars can be removed and repaired.

Brian: What are some of the goals of your kinetic architecture? Is there the potential that kinetic architecture can increase efficiency? Do the methods by which these kinetic systems and computational subsystems are produced lend themselves to mass production or do they remain unique responses to unique situations?

Michael: Most of this I have answered in the first additional question, but I will answer in response to mass production vs. unique situational use. Probably the most innovative designs will always arise from unique situational use, and a driving force lies in the changing patterns of human interaction with the built environment. The ability to not only monitor but also physically control remote environments may have consequentially important implications. I think there is a great potential for applications that arise from understanding what an architectural space or object is currently doing and how it can do it better: How can issues of privacy and public be dynamically responded to? How can thermal, visual, and acoustic conditions be dynamically responded to? How can spatial sharing be optimized, and natural daylight articulated? And how can architecture extend the notion of enhancing our everyday activities by doing things that are impossible or very difficult for us to do. We should really ask not what architecture is, but what can it do.