Distributed *Pneu* Elements for Surface Kinetics

The presented project is a part of a larger body of an ongoing design research that investigates the potential for kinetic and responsive architectural skin systems to influence the use of space and users’ behavior. The project explores the integration of custom-made soft robotic muscles into a component-based surface. The result of this project is a prototype of a light modular system capable of kinetic response to external stimuli such as occupancy or atmospheric conditions. The project focuses on kinetics of architectural surfaces and tectonics that integrate stasis and motion. It investigates the potential for a ‘programmable’ architectural modular system that simultaneously addresses stability, dynamics and adaptability of a singular system.

In the Introduction of his 1970’s book *Kinetic Architecture* William Zuk, who was an engineer, architect and educator at the University of Virginia, speculates about changes in design approach necessary to envision architecture capable of kinematic movement (William Zuk, Roger H. Clark, *Kinetic Architecture*, Von Nostrand Reinhold Company, New York, 1970). He suggests that new construction techniques, materials and technologies would have to be established. But, even though, kinetic architecture will require a more mechanistic and technological approach through the use of sensing technologies, new materials and embedded computation, it may also usher a new kind of relationship between the human body and space. According to him social relationships as well as personal sense of space and enclosure would be challenged. Associations between a dynamic body and dynamic space could provide a context where organization of human activities and experiences becomes more sensitive and responsive to changing needs, form, and phenomena.

The project presented here looks for an alternative relationship between body and space. It uses soft pneumatic muscles as a form of actuation, seeks seamless transition between hard and soft elements of the modular system and tries to imagine new realities in which we can build responsive building skins that more intimately relate to the human body.

In particular the project explores the capacity of *pneu* structures to produce a kinetic effect in architectural surfaces. Being delineated by an elastic membrane the *pneu* structure responds to the change of pressure by changing its mass. The change in pressure can cause considerable physical transformation of the structure. In this project the capacity of *pneus* to deform is used to produce kinetic effects in a larger construct and utilized to produce many different configurations. This research demonstrates the possibility to move parts of the aggregated structure by inflating and deflating integrated soft components (*pneu*). Degree of precision and control of movement depends on the volume and form of the soft component.

The primary advantage of this mode of actuation is its lightness as well as a degree of control of movement. Another aspect is integration between the actuators and the system components. They are both modular and by fitting together they can be seamlessly integrated into one materials system.
‘Programmable’ architectural modular system simultaneously addressing stability, dynamics and adaptability of a material system