The Interplay of Figures Using Superimposed Arrays

Kory Bieg

1 The University of Texas at Austin
1 kory@otaplus.com

This paper introduces the theoretical considerations underlying the design of a digitally designed and Computer Numerically Controlled (CNC) fabricated public installation project in the city of Austin, Texas. The project, The Creek Zipper, is an assemblage of exo-related units that symbolically reconnects two divided city neighborhoods, establishes a new relationship between the synthetic and natural, and inflates a two-dimensional graphic into a three-dimensional form. The project can be clearly read as a whole from a distance, but as one approaches, the legibility of each part begins to overwhelm the perception of the whole. As the form of the whole dissipates, the project gains a field-like presence, revealing different sets of discrete figures nested within the larger whole. The Creek Zipper addresses these multiple overlapping dichotomies that act as design generators and promote a dynamic expression of the project.

Keywords: Array, CNC, Part Whole, Curve, Installation, Fabrication

PROJECT BACKGROUND
The Creek Zipper is one of five temporary installation projects located on Waller Creek, which is in the process of undergoing a radical infrastructural transformation.

The city of Austin is constructing a flood-control tunnel to mitigate the devastating effects that torrential rain has imposed on the area. In the past, flooding at Waller Creek has made roads impassable, disconnecting the east side of Austin from downtown. Once the tunnel is complete, this incredibly active and important thoroughfare will remain open even during the worst storms, providing a connection between two vastly different but equally important neighborhoods.

The Creek Zipper fosters a new experience of the creek that is grasped from multiple perspectives, including from the pedestrian bridge that spans it, a stairway that leads down to the water from the bridge, and from the level of the creek.

Although the tunnel will alleviate flooding, the potential for flood-like conditions remains. Nature consists of a dynamic set of relations, including an occasional overabundance of rain. Despite our every effort to contain it, excessive rainfall will continue to pool in highly constructed, urban areas that lack adequate soft scape to shed and absorb water. Even though the tunnel will control flooding caused by excessive rainfall in the immediate future, we shouldn't forget the fragility of artificial structures—a mistake that led to the devastation of New Orleans when a levee failed during Hurricane Katrina.

This installation addresses the temporality and instability of synthetic structures that attempt to interface with and control natural dynamical processes. (see Figure 1)
FLOODING IS A HYPEROBJECT

Flooding is an example of what Timothy Morton calls a hyperobject. A hyperobject is a “thing that is massively distributed in time and space relative to humans . . . they involve profoundly different temporalities than the human-scale ones we are used to.” (Morton 2013, p.1) Flooding can have an effective range far greater than any singular event and is often so vast that we have a difficult time predicting its frequency or impact on our environment. A flood is more than the weather event itself; it is the infrastructure that fails, the displacement of people, the destruction of property, and more. Conceptualizing flooding as a hyperobject forces us to design our interventions in relation to the past, present, and future.

Once the tunnel project is complete, people will be able to enjoy a walk along the creek with a reduced fear of sudden and catastrophic flooding. But we must not forget the power of nature: a release of a valve and this safe paradise could become awash in ruin and destruction. The goal of The Creek Zipper is to make visible the ebb and flow of a dynamic creek, so our awareness of its energy-including its capacity to flood as a result of heavy rains—is also dynamic, never lulled into complacence.

THE CREEK ZIPPER: PRODUCTIVE CONTRADICTIONS

The zipper installation is, like the creek itself, an open and dynamic system. The form of the project responds to a series of limestone shelves that sit just below the water line. The project is made up of interweaving strands divided into unique modules. The modules, fabricated of aluminum, are raised at intervals, by a series of adjustable pedestals. The flat bottom of each module coincides with the average water level. When the water level is below average, the water passes underneath the strands and is only minimally affected by the legs that support the modules. When the water level rises even a small amount above average, the water interacts with the folded geometry of the modules, causing a turbulent flow. Without the installation acting as a gauge, this rise in the water level would be nearly imperceptible. The zipper—as both an object and a representation of wa-
ter flow—makes the force of water more legible, and serves as a reminder of the power of the creek in flood. The project represents a momentary and unstable synthesis between a natural process and synthetic construct. (see Figure 2)

The Creek Zipper is a group of strands that emulate the zipping of two strings of teeth. Each tooth in the string is connected to its neighbor, as well as to a spine that is anchored to a series of existing concrete steps used by pedestrians to cross over the creek. A zipper operates as a nonlinear system—that is, it maintains the capacity to shift between the poles of “open” and “closed”, or back, at any given time. By delaminating a single pair of zipper strands into a series of strands that split, merge, and intersect, the project exposes the full potentiality of a zipper; sometimes open, sometimes closed, and often in between. The superimposition of overlapping systems provides balance to the project, both conceptually and structurally, and affords a multiplicity of meanings. (see Figure 3)

In Complexity and Contradiction, Robert Venturi argued that “an architecture of complexity and contradiction . . . tends to include ‘both-and’ rather than ‘either-or.’ If the source of the both-and phenomenon is contradiction, its basis is hierarchy, which yields several layers of meanings among elements with varying values.” (Venturi 1966, p.23) The delaminated zipper expresses variation at multiple levels of the project: in each module within a strand, among strands, and in the overall project form. Variation is applied at each level, introducing conflicting sets of data that are resolved hierarchically according to part-to-whole relations. Venturi continues: “Both—and refers to the relation of the part to the whole. Both-and emphasizes double meanings over double-functions.” (Venturi 1966, p.34) By delaminating a single pair of strands into multiple strands, we reveal all possible meanings at once, expressing a zipper form’s full potential, even when such multiplicity invites contradiction. In this case, contradiction is not a reduction, but an amplification of meaning.

**PART WHOLE LOGICS AND ARRAYS**

The Creek Zipper is an array of arrays. The project is a stable and complete whole, but is also made up of strands that are wholes in and of themselves. Furthermore, each strand is made up of parts that are likewise wholes, with each part able to stand on its own. Each part, strand, and whole is parametrically linked to each other through a Grasshopper definition. Although each part is a whole, properties of the parts are linked to the parametric properties guiding the form of each whole, whether that be an individual strand or the overall project form. While each part is a subset of a whole and some parts are subsets of larger wholes, there is another category of part-to-whole relation that influences the form of parts.
across sets: that is, there are parametric relationships between disconnected sets. Though some parts are not physically connected to each other, some of their parameters are linked, such that a change in one value of one part might have an effect on the parameters of another part, or even a whole form of a different set. (see Figure 3)

Breaking a whole into parts further allows for the introduction of additional object properties, which increases the qualitative impact of the project exponentially and diversifies the capacity of the project to connect to its environment. (Harman 2007, p.26)

The high level of differentiation from unit to unit promotes the variation of shared qualities. For example, reflectivity, light, form, size, and color are properties common to all units, but vary from part to part to fully express a range of effects found in the whole. (Bryant 2011, p.20) By nesting multiple arrays within different sets, we expand the project’s effects, qualities, and properties. Conflating the sets introduces more productive contradictions.

OTHER CONTRADICTIONS
The creek flows between 6th and 7th Street in downtown Austin, Texas; thus, one encounters the project from two vantage points. As Sigfried Giedion notes, “the presentation of objects from several points of view introduces a principle which is intimately bound with modern life-simultaneity.” (Giedion 1959, p.369) The first view of the project is from the bridge above. Visitors see the overall form as a two-dimensional graphic overlaid on the creek be-
Once people descend the stair and view the project at eye level, the two-dimensional form inflates into a three-dimensional series of highly differentiated units. One experiences the project as both graphic and form. As Robins Evans notes in his book Translations from Drawing to Building, “To imply depth with in a solid three-dimensional body is to conceive of it as being made up of flat surfaces modulated within a thin layer yet giving the impression of being much deeper. It is to attempt to make virtual space and real space at one and the same time and in the same place... for into patterns of lines stopping and starting we project, by a well understood reflex of overdetermination, a deeper space.” (Evans 1997, p.169-170) This deeper space is activated by the creek over time and the piece is transformed as the water level rises and falls. (see Figure 5)

To add another reading of the project, we used over one thousand battery powered lights in the installation. By including so many lights, we were able to introduce subtle variations by mixing different light types and colors, further decomposing the whole. The low-intensity light reflects off the water, adding a dynamic quality to the project, connecting the synthetic qualities of the installation to the natural conditions of the environment. During the day,
the satin-finish aluminum reflects the surrounding context and sky. At dusk and dawn, the aluminum reflects the first and last vestiges of sunlight, while the “artificial” light seeps out from beneath each module’s hood.

PARAMETRIC DESIGN
By mixing different, yet continuous fluid forms into one geometry, we introduce disruption in the form of overlap. This subtle distortion in the form of the zipper demands a certain level of attentiveness that is not evident on first view of the project. To achieve this effect, we used Grasshopper to govern the parametric relationship between the strands and the individual parts. By using one Grasshopper definition, we were able to retain full parametric control over every aspect of the design. This allowed us to introduce design variables that affect the geometry in various ways throughout the project. For example, design changes at the scale of a module impact parameters
of a strand that are not physically connected to the module that is linked to the effect. (see Figure 6)

The process began with a drawing of the initial curves on a plan of the site. The curves included three unique conditions: (1) single strands of individual modules; (2) overlapping strands, in which two sets of modules are superimposed using the parameters of each to define a third module type; and finally, (3) modules at strand intersections. We used the intersections to define the transition points for the different strand and module types. The modules at these intersections are unique parts in the array that compound the object properties from each strand at one moment, causing a feedback of new properties to ripple back into the individual strands. These units are what Deleuze and Guattari refer to as operators. (Bennett 2010, p.9) The operators act as culling mechanisms and determine which data to use when conflicting data sets feed into a single parameter. They also initiate transformation in the form of module and strands both locally and globally. (see Figure 7)

Once the overall strands were outlined, each strand was divided into two series of interlocking teeth. The teeth are inset to provide a pedestal from which the rest of the module, including flaps that fold up to support a hood, are generated. We used a gradient bitmap to control subtle parametric variations of the project, including the module width and height, the size of the flaps, and the height of the hood. The final step added details for fabrication, including bolt holes, numbers, and tooling profiles.

Though the modules appear to be similar and vary only slightly, a deeper level of variation is evident on closer inspection. The modules are based on a generic prototype, but the exact form differs de-
pending on whether they fall within a single strand set, an overlapping set, or a superimposed set of strands, or if the module is at the intersection of multiple strands. These unique module types drive the differentiation found in the project and yield different readings of the project, depending on the viewer’s standpoint. The project is only fully revealed once it is viewed from multiple locations and from multiple distances.

CONCLUSION
To make visible the capacity and effects of something as all-consuming and complex as flooding, we designed an installation that not only represents the dynamic form of the event, but fully exposes all the possible states of itself at one time through differentiation and multiplicity. The form of the project is a zipper, a form that works through overlap and interconnection. Rather than construct a single zipper that is static, we chose to delaminate the project and use multiple strands to convey multiple configurations and states of the form. As a result, the Creek Zipper expresses a temporal range that allows for a multiplicity of meanings and effects to emerge. By delaminating a single strand into many, we introduce additional module types that increase the qualities of the project while providing additional ways for new effects and meanings to emerge. (see Figure 8)

Only when we acknowledge that the past and future are as impactful on a site as its present conditions can we be conscious of the energy potentials that are latent to any particular site. Waller Creek has flooded many times in the past, and no amount of infrastructural investment will remove its inherent capacity to flood in the future. As David Ruy notes: “The mythological image of nature in equilibrium continues to be a dominant cultural mindset despite its obvious sentimentality. All observable evidence indicates that nature is not and never has been in a state of equilibrium. Careful observation has always revealed nature to be in a perpetual state of flux. If we are to take the flux of nature seriously, we would then have to understand sustainable practice as a willful act that seeks to maintain an artificially constructed equilibrium.” (Ruy 2012, p.40) By creating an installation that actively engages the material of the site (water) and its capacity to change, we shed light on the dynamic nature of the environment and offer a better fusion of the synthetic with the natural. By using a relational part-to-whole model that oscillates between hierarchical systems, while offering sometimes contradictory sets of data in the code for the design, we compound the effects produced by the project. By using pattern and form to weave a two-dimensional graphic into a three-dimensional volume, we open a new space for meaning, heightening one’s awareness of the project and the site itself. Only when the latent capacity of the site is made visible are we able to appreciate the flux that is always operating at some scale, and the comprehension of that flux needs to be constantly refreshed if we are to achieve a balance with nature that is stable and sustainable.

REFERENCES
Bryant, LR 2011, The Democracy of Objects, Open Humanities Press, Ann Arbor
Morton, T 2013, Hyperobjects: Philosophy and Ecology after the End of the World, University of Minnesota Press, Minneapolis