author: George L. Legendre
organization: Design Critic, Harvard Graduate School of Design and Architect
country: United States

Parametric Surface Redux: IJP (Finally) Explained
Data matters. Imagine a model of variation exploring ways in which distinct quantities that vary in relation to the same fixed range relate to one another. Such a model would compound any number of dependent relations and fuse their respective behaviors into a single space. The result could be ambiguous, but always full of potential.

Taken separately, dependent relations are limited to the expression of variation relative to a uniform pattern, but their composition reveals a more complex pattern, the pattern of one variable in relation to another. The pairing records flux in relation to flux, as it were, and establishes a multivariate system of constantly mutable terms. With one more definition added to a semantically crowded field, this model of variation is said to be parametric, and most complex three-dimensional surfaces follow it. Parametric surfaces display the continuous interplay of three mutable terms, one per dimension and spatial coordinate, each of which expresses a relation between a dependent variable and two independent ranges, bound, for general applicability, between 0 and 1. Mathematicians typically notate these ranges with the symbols of $i$ and $j$, two characters which found their way into the title of this abstract, the title of this writer’s first book, *IJP The Book of Surfaces* (2003), and the trading name of his practice).

In space, three-dimensional parametric surfaces combine three such dependent relations by blending their respective surface plots. They thus form—and deform—in direct response to the relations they hold in their midst. To the observer who knows where to look for them, the conformation of the parametric surface exhibits and retains the traces of these internal motions as markedly as the plump figure of midlife will subsume the sharper inflections of a youthful physique. Parametric surfaces surge upwards because of the generic antecedent of linearity, a pattern of linear growth exhibited to some degree by one of the dependent relations they quite literally incorporate. They undulate by peaks and depressions because of a periodic internal makeup, which points to the presence of cyclical behavior in some of their three respective antecedents. Finally, they spiral up and down under the confluence of linearity, periodicity, and transposition. Each term of the transformation follows a distinct pattern and determines the overall form of the surface in tandem, or against, the other two, through a composite process yielding complex results.
This is the knowledge model we’ve been developing at IJP in order to conceive of and build ground-breaking structures, large or small, since the inception of the practice in 2004. The Henderson Waves Bridge (Singapore 2004-09, with RSP), the Shenzhen Museum of Contemporary Art and Planning (PRC 2007, with Max Kohlen), F01(b) (in collaboration with artist John Pickering, London 2009), the Art Fund Pavilion (London 2009), and the Yeosu Expo 2012 Thematic Pavilion (South Korea 2009) all follow precisely the same instrumental premises.

While acting as parts only in a loose, strictly functional sense (inasmuch as you can manipulate them independently to inflect the configuration of the whole), the parametric relationships expressed in these projects are not parts. Their role is neither ‘pure’ nor distinct, and the combined impact they visit on the parametric body muddles their respective areas of influence. Thus a form shaped by parametric modulation has no discrete limbs to speak of, you cannot chop it off into pieces, nor indulge in the separate application of permutation, substitution, and scaling of parts, to which architectural parametric ‘invention’ is typically reduced. Consider for instance the parametric figure of the pillow, on which the superstructure of Henderson Waves, the tallest pedestrian bridge in South-East Asia, is based. What exactly, if anything, is the pillow made of? The parametric pillow form is a common surface obtained by composing one linear transformation with two periodic ones. The first transformation is linear; its surface plot, the three-dimensional equivalent of the graph curve, is a plane. The second transformation is more complex; it gives us a series of periodic oscillations, and hence, its surface plot flows in the wavelike course of a sinusoid. The third, a cross-product of periodic oscillations, 180 degrees out of phase that spread in perpendicular directions, yields a weave-like arrangement of peaks and depressions. The forms of these three antecedent surface plots explain the motions that shape the parametric surface in breadth, width, and depth, and clarify—if you can unravel their interplay, that is—why it looks the way it does. The reflexive symmetries of the pillow have to do with many periodic cycles, whose beginning and end necessarily coincide (aren’t all sinusoids potentially symmetrical?); its standing on the edge, upright, and seemingly gravity-defying, will be traced back to a linear range increase. And as the ranges vary, the pillow’s cell-like subsequent division into two, three, or more swelling bulges—as if constricted in multiple places by tightly knotted pieces of ribbon—reflects the number of trigonometric revolutions fed to a periodic function and determines the structural units of the bridge.

The plane rises, the wave dives (and then surges again). The crossing ripples swell. None of these surfaces, I think, looks like the pillow itself. None of them resembles the parametric form, that is, and yet they all jointly determine it. Had they not been...
there, the surface could not have been anticipated—because you cannot model it simply by deforming other surfaces, however sophisticated and powerful your software may be. Had they not been identified as antecedents, the surface could not have been retrospectively read. With their dependent functions, variable parametric surfaces are both a means to complexity and the way out of its mystifying embrace. They are, in other words, the ultimate object of knowledge.

References