Hyperspatial Interlace. Grasping Four-dimensional Geometry Through Crafted Models

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Although our everyday perception of space tells us that it is composed of three spatial dimensions of length, height and width, it is possible to imagine a space having four spatial directions that are exactly identical with respect to each other, and meet at right angles. This concept of a four-dimensional space has had a profound and lasting effect not only on philosophy, mysticism, mathematics, and theoretical physics, but also on fiction and visual arts.

Because the mathematically described four-dimensional structures are difficult to grasp visually, it is instructive to observe spaces of lower and higher dimensionality in their hierarchical relation. In this context we can see that our challenges to understand and visualize four-dimensional objects are analogous to the difficulties a two-dimensional being, confined to a plane, would have with respect to our three-dimensional space and its shapes. Consequently, just as three-dimensional structures can be drawn, unfolded, sliced, photographed or otherwise projected onto a two-dimensional medium like paper or a computer screen, these graphical techniques can be generalized to acquire the three-dimensional appearances of the four-dimensional hypersolids.

The objective of the artistic research reported here was to craft physical, three-dimensional models that illustrate regular hyperspatial structures through novel visualization methods. I considered kinetic models of the four-dimensional polytopes in particular to be beneficial for understanding these structures. As a research method I employed experimental crafting with traditional materials and techniques, and the theory guiding these constructions came from the field of descriptive geometry. The cultural references in the history of hyperspace, such as interpretations in spiritualism and science fiction, served as a poetic inspiration in designing the models.

As the results of my research, I present five concepts for physical models, each of which illustrates a hypersolid through a different visualization method. The set of objects consists of a stereographic projection of the hexadecachoron made from brass hoops, perspective models of the tesseract in steel wire and paper, the bitruncated versions of the pentachoron and the tesseract in topological cloth patchworks, a set of stick models depicting the icositetrachoron in a gnomonic projection, and a beadwork 'cavalier projection' of the 3-3 duoprism.

These objects illuminate new connections between arts and mathematics, and serve to enrich the morphological repertory of visual art practice with novel means and meanings. As pedagogical tools, the models pursued offer a hands-on experience of hyperspatial geometry, thus democratizing pure mathematics. In the context of artistic research my work presents itself as an example of an unconventional multidisciplinary methodology.

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