Self-Assembly of 3D Magnetic Tiles

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Abstract

Self-assembly is a term most commonly associated with biological processes, especially cellular manufacture of DNA. By utilizing a four element code, cells are able to actively reproduce the genetic framework of life. By applying a similar principle to the macro-scale, tangible 3D objects can be fashioned by a coded series of simple building blocks. The goal of this paper is to examine the fabrication needs of macro-scale 3D self-assembly. A simple way of showing 3D self-assembly is by manufacturing a chain of tiles implanted with permanent magnets. The tiles are coded by the relative orientations of two pairs of embedded NdFeB magnets. At each tile interface, the chain is bent by the simultaneous attractive and repulsive forces of the magnet pairs. Using this information, chains are coded to automatically fold into any shape without self-intersection. The principles outlined above will be shown through physical demonstrations wherein a coded chain self-assembles into a 3D object. To accomplish this, the chain is injected into a buoyant environment through a chute of comparable diameter. Beyond the scope of this project, future challenges to 3D self-assembly include applications to MEMS-scale projects and applications to practical macro-scale products.