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A hierarchical framework model for constructing heptagonal quasi-periodic tiling

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Abstract

The discovery of complex patterns in historical Islamic architecture that exhibit non-periodic symmetries is providing new insights into understanding the underlying structure of many quasi-periodic tiling patterns. Traditionally, the manipulation of circles, straight lines and their intersections provides the underlying hierarchical structure for guiding the creative development of the different quasi-periodic designs. Previous research has demonstrated the use of the hierarchical framework method for generating a wide spectrum of quasi-periodic tiling, including Penrose tiling and Ammann tiling. This paper expands on the range of quasi-periodic symmetries tested by this method to explore the underlying structure of heptagonal quasi-periodic tiling. Derived from these traditional principles, this paper presents a global multi-level hierarchical structural model that is able to describe the underlying structure of heptagonal quasi-periodic tiling. Moreover, this method can be used as a general guiding principle for constructing a wide variety of heptagonal quasi-periodic patterns without the need for complicated mathematics; providing an easy tool for scientists, mathematicians, teachers, designers and artists, to generate and study these complex symmetries.

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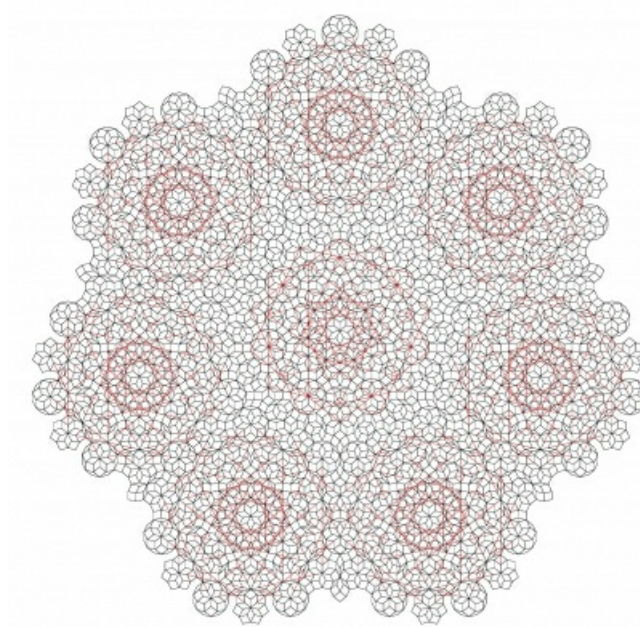
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