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New geometric algorithms for fully connected staged self-assembly. (English) Zbl 1370.68089
Theor. Comput. Sci. 671, 4-18 (2017).

Summary: We consider staged self-assembly systems, in which square-shaped tiles can be added to bins in several stages. Within these bins, the tiles may connect to each other, depending on the glue types of their edges. Previous work by Demaine et al. showed that a relatively small number of tile types suffices to produce arbitrary shapes in this model. However, these constructions were only based on a spanning tree of the geometric shape, so they did not produce full connectivity of the underlying grid graph in the case of shapes with holes; self-assembly of fully connected assemblies with a polylogarithmic number of stages was left as a major open problem. We resolve this challenge by presenting new systems for staged assembly that produce fully connected polyominoes in $O(\log^2 n)$ stages, for various scale factors and temperature $\tau = 2$ as well as $\tau = 1$. Our constructions work even for shapes with holes and use only a constant number of glues and tiles. Moreover, the underlying approach is more geometric in nature, implying that it promises to be more feasible for shapes with compact geometric description.

MSC:
68Q05 Models of computation (Turing machines, etc.) (MSC2010)
68Q10 Modes of computation (nondeterministic, parallel, interactive, probabilistic, etc.)
68Q25 Analysis of algorithms and problem complexity
68U05 Computer graphics; computational geometry (digital and algorithmic aspects)

Keywords:
self-assembly; staged assembly; fully connected assemblies; geometric algorithms

Full Text: DOI arXiv

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