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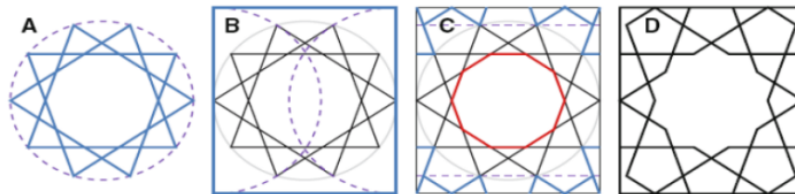
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## Application of iterative geometric algorithms in contemporary architecture

Architecture, as the process of designing and constructing buildings and other structures, combines art and engineering since it put together aesthetic and utility of structures. Aesthetics usually refers to the geometric form of a structure whereas utility – to its mechanical (physical) properties.

In architectural design we frequently meet the geometric problem of arrangement of certain objects or shapes (e.g. polygons, points, tiles of a mosaic) filling a bounded region of space and satisfying aesthetic requirements which cannot be easily expressed in terms of exact criteria [1], [2]. However, it is known that patterns with symmetry, periodicity and fractal or a little chaotic properties seems to be nice [3], [4]. In particular, aesthetic perception of Islamic architecture mosaics is achieved by periodic and/or symmetric arrangement of geometric figures such as polygons. “Islamic” designing is usually based on a sequence of simple geometric operations such as A,B,C,D presented below [5]:

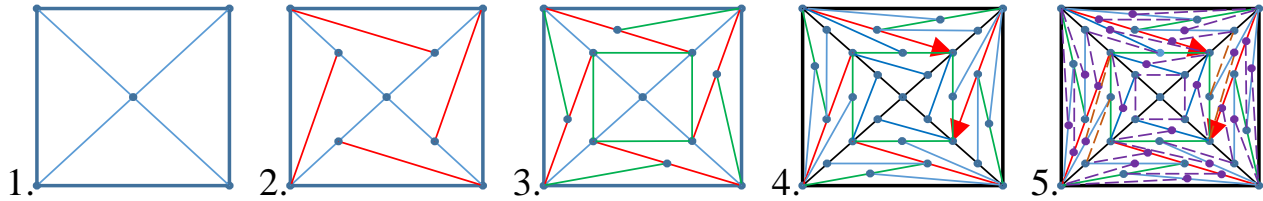


In this work the general problem of aesthetic arrangement of points filling a bounded region of a plane is considered. It is proposed to generate sets of points by appropriate geometric point iterative algorithms determined by

- $D_0$  – basic filling domain (e.g. a room floor or a tile of the shape filling a bounded region of a plane),
- $P_0$  – initial points belonging to the boundary and/or interior of  $D_0$ ,
- $G$  – a geometric iterative procedure producing sets of points  $P_k = G(P_0, P_{k-1})$ ;  $k = 1, 2, \dots$  in subsequent iterations that can be easily described verbally and implemented as a computer code.

Aesthetics is achieved by a visual (subjective) choice of some patterns out of many ones produced by the applied geometric iterations. An example of such geometric

iterations on a square with five initial points is presented below:



The possibility of combining various algorithms of the same domain  $D_0$  is pointed out. Applications of the described procedures in designing floor or wall mosaics and LED ceiling lights are presented.

### References

- [1] W. Blackwell, *Geometry in Architecture*, John Wiley & Sons, London, 1984.
- [2] K. Kajewska, *O symetriach wzorów płaskich*, praca magisterska, Uniwersytet Wrocławski, Wydział Matematyki i informatyki, 2014.
- [3] N. Sala, *Fractal geometry and architecture: some interesting connections*, WIT Transactions on The Built Environment 86, 2006 WIT Press. History. New York: The Metropolitan Museum of Art, 2000.
- [4] Department of Islamic Art. *Geometric Patterns in Islamic Art*. In: Heilbrunn Timeline of Art History, New York: The Metropolitan Museum of Art, 2000.
- [5] L. M. Dabbour, *Geometric proportions: The underlying structure of design process for Islamic geometric patterns*, *Frontiers of Architectural Research* 1 (2012), 380–391.