Blocklizer: Interactive Design of Stable Mini Block Artwork

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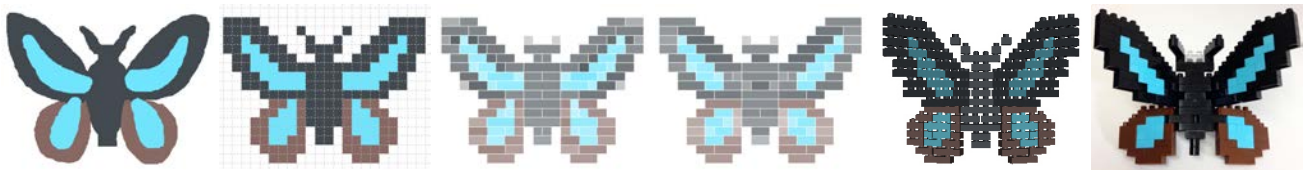

Figure 1: *A complete design of mini block artwork. (a) 2D defining features input. (b) Sampled defining features. (c) Automatic pattern layout informing stability. (d) Interactive detail modification considering stability. (e) Assembling and Building guide. (f) Real block work.*

1 Introduction

LEGO consists of colorful interlocking bricks easy to be binded with each other. Automatic layout for better interlocked models, namely "more stable" models suggested by LEGO, has been formulated as a combinatorial optimization [Gower et al. 1998] to merge voxels in pre-sampled binary volume model into basic bricks (Figure 2a). However, to create mini sized block artwork (e.g. under 200 pieces, Nanoblock mini collection[1]), an exploring process for better feature abstraction is required. It seems that compared with automatic layout systems, interactive free modeling tools (e.g. LEGO Digital Designer, Build With Chrome) win more popularity among amateur players of block productions. These free modeling systems have a better interactivity than automatic ones, but basically they hardly support stability optimization for brick layout.

We introduce an interactive system called *blocklizer*, to contribute to exploring stable but well abstracted design for mini block artwork by adapting stability optimization to user's modification for expected structure. A painting interface is implemented to assist novices lack of block experiences or amateurs in sketching colorful *defining feature* (D-feature) expected in block model. These D-features are organized by different Z-order layers to handle the overlap. Such a layer structure is also well suitable for making building instructions which can guide real block work.

2 Proposed Method

In our system, a global brick layout is analogous to the utilization of stamp in Photoshop for pattern tiling on feature mask drawn by pencil or extracted by color. Stamp of a certain pattern corresponds to brick wall with a specific layout structure of which stability has been optimized in advance. Initially, D-features are designed and separated into different layers considering user's vision for features' functions (e.g. deformability). To maintain the unity in a D-feature, only one pattern can be applied to each D-feature layer. To further modify pattern results interactively, layer operations (combine, subtraction, move up and down) and brick editing tools (add, delete, split and combine) are provided. With these tools, users can correctly design a variety of block artwork, even a highly abstracted small sized one owning many tiny features.

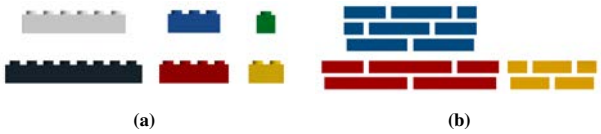

Figure 2: *(a) General basic bricks used in automatic layout. (b) Brick wall patterns using Brick 1x2, Brick 1x3, and Brick 1x4.*

To achieve a stable brick layout on a hand-drawn D-feature, stability optimization is implemented during the global layout pattern tiling and the local detail modification as well. Stable brick layout patterns for automatic tiling (Figure 2b) are designed by considering both of ideal walls with good structures [Gower et al. 1998] and symmetry under Euclidean transformation group. When modifying pattern results, a real-time optimization test is activated informing the variation of stability by changing the transparency of bricks affected. Brick less transparent is more stable. The calculation of stability for each brick is based on the definition [Petrovic 2001] modified from the classical heuristics for stable solutions.

We implemented a GUI that allows navigation through five editing steps (Figure 1) to achieve a complete design of mini block artwork. 2D and 3D results are rendered simultaneously in different views. Besides a rendering usage, the view for 2D results is also the canvas for drawing and repainting the user inputs, while the view for 3D results plays a role of assembling plant treating bricks in each layer as an integral part. Current system implements a layout of brick wall merely on the side view, creating a 2D layout result with thickness of 1 along Z-axis. By handling 2D layouts layer by layer, not only 2D block works, but also many attractive 2.5D and 3D ones can be created. However, to design more complex 3D block artwork, layout patterns on other views (end view and top view) will be considered in the future.

References

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[1]http://www.diablock.co.jp/nanoblock/catalog/minicollection

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