FAKULTÄT FÜR !NFORMATIK
Faculty of Informatics

Diplomarbeitspräsentation

A Framework for GPU-Assisted Generation and Composition of Inductive Rotation Patterns

Masterstudium:
Visual Comptuing

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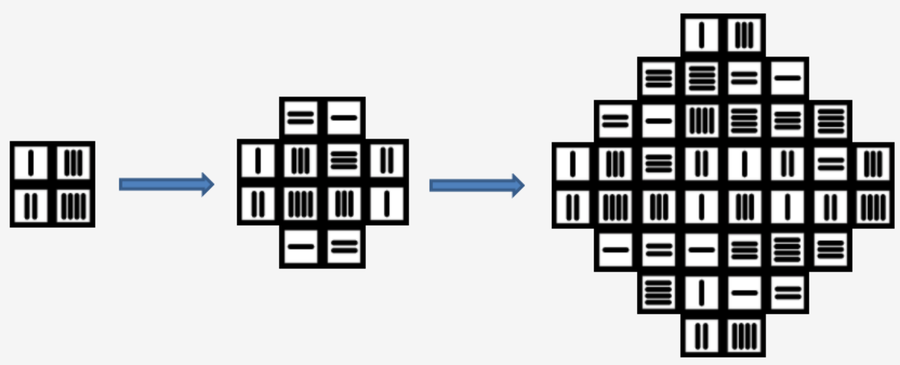
Kurt Hofstetter

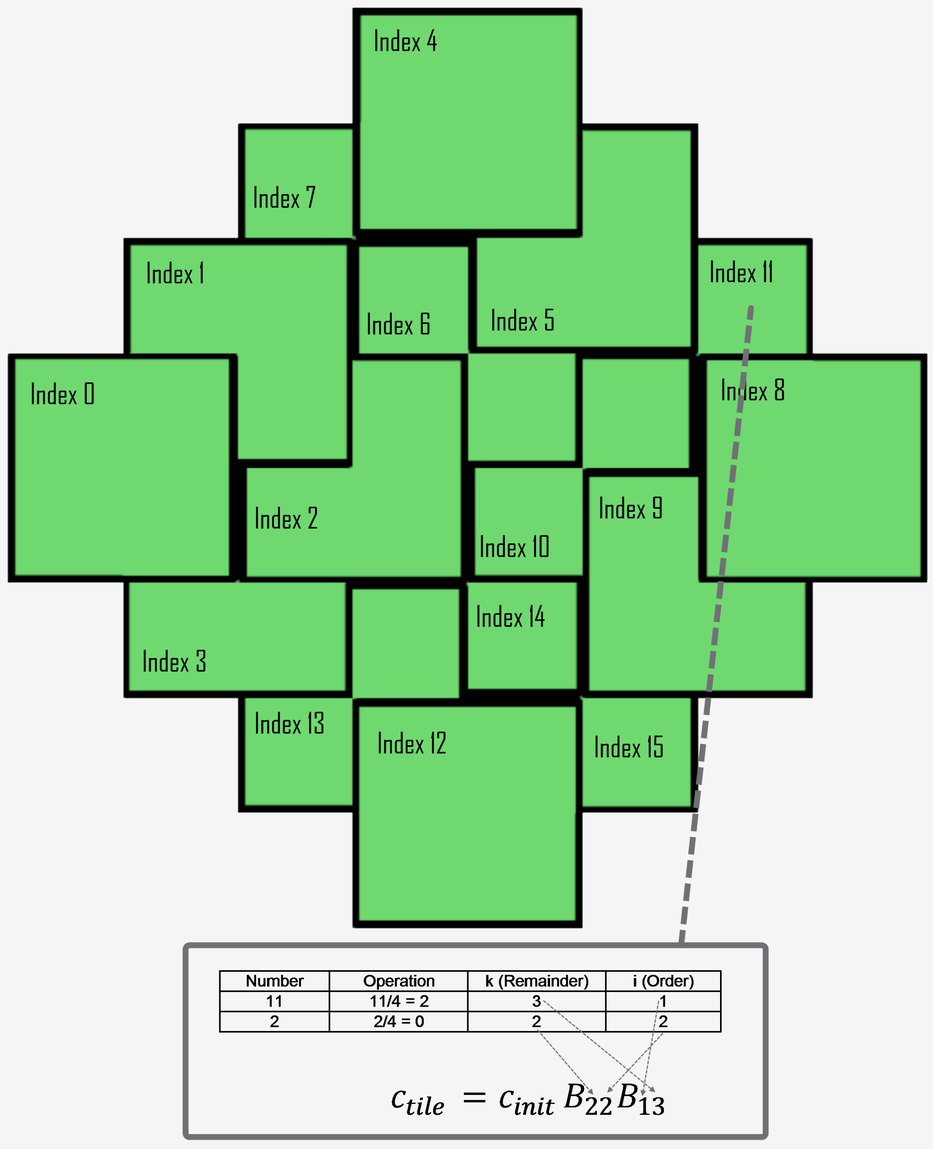
Problem Statement

The Inductive Rotation (IR) method, developed by the artist Hofstetter Kurt, creates two- dimensional, aperiodic patterns by applying recursive transformations to the copies of a single prototile. The aim of this thesis is to parallelize the existing pattern generation algorithms via GPGPU methods, to investigate the properties of a newly developed tile substitution algorithm for pattern generation and to improve the artist‘s design process by providing an extended tool-set like a graphical prototile editor.

3-way Inductive Rotation



Parallel Approach



Number	Operation	k (Remainder)	i (Order)
11	11/4 = 2	3	1
2	2/4 = 0	2	2

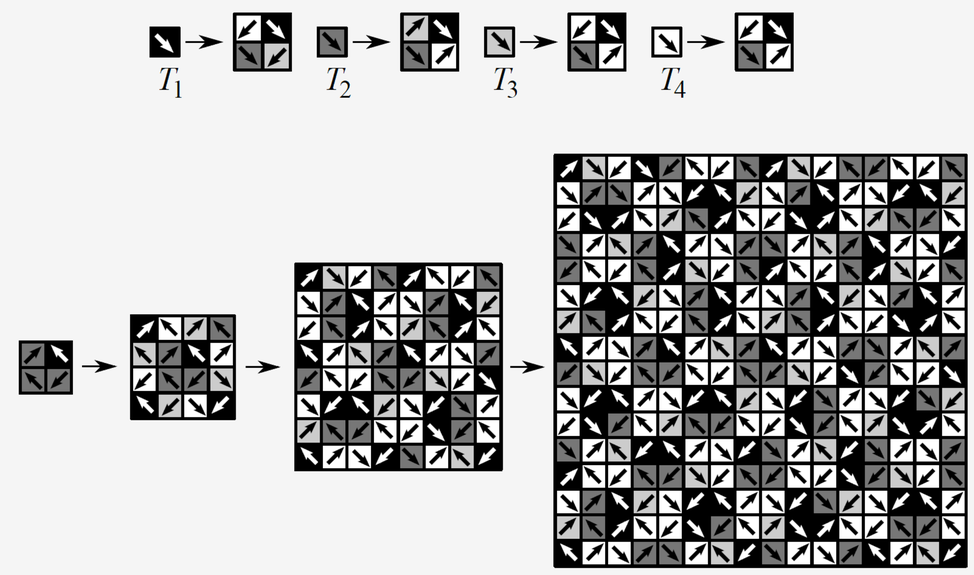
$$c_{tile} = c_{init}\, B_{22} B_{13}$$

Algorithms

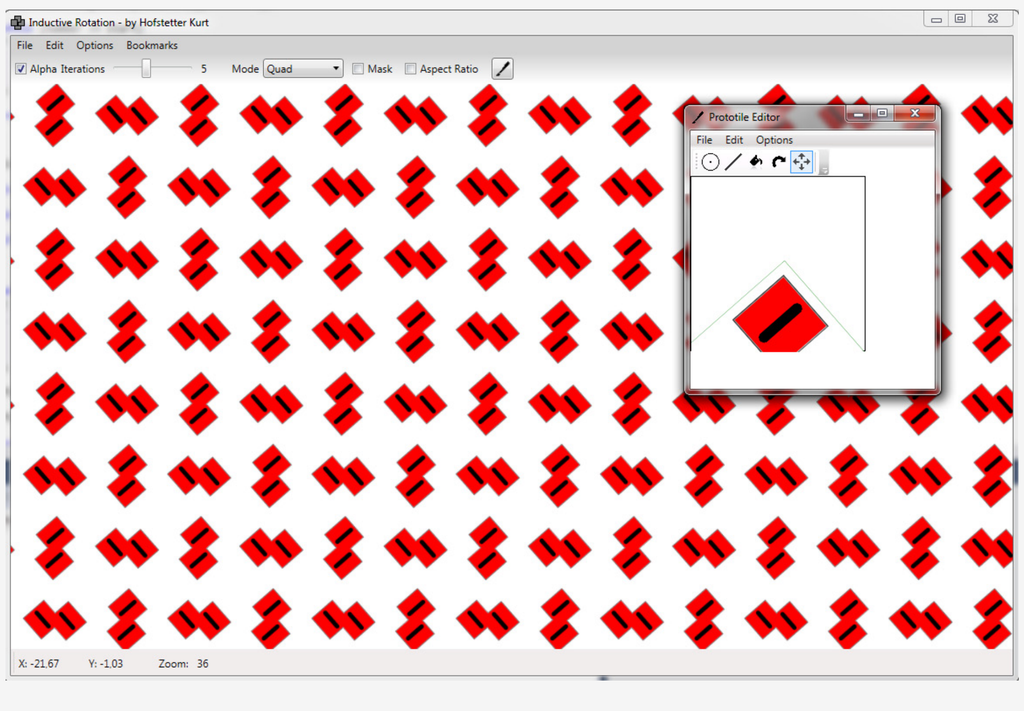
The thesis contributes a new algorithm for generating Inductive Rotation patterns, the **parallel approach**. The algorithm assigns an index to each tile and then uses an idea known from numeral system conversion, which is again based on Horner‘s method, to map the index of a tile to a chain of transformation matrices. This chain of matrices is then used to determine the exact position of each tile within the pattern. These mappings are then executed in parallel via GPGPU methods.

The thesis also implements an algorithm based on work of Frettlöh and Hofstetter [FH15], the **substitution tiling approach**. The algorithm uses four different rules to replace each tile in each iteration, similar to simple L-Systems. This approach generates a tiling that *contains* a 3-way IR pattern.

Substitution Tiling Approach



The Framework with the New Prototile Editor



Results

The **parallel approach** allows the artist to generate patterns that are about 12 times larger compared to previously existing approaches. The approach also increases the generation speed for large patterns. The extended toolset, especially the integrated prototile editor, have proven useful to Hofstetter and will aid him in future artistic experiments.

[FH15] Dirk Frettlöh and Kurt Hofstetter. Inductive rotation tilings. *Proceedings of the Steklov Institute of Mathematics*, 288(1):247-258, 2015

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