# Abstract

Arranging elements in a design domain is an essential task in visual design because human visual perception is sensitive to the layout of the elements. Moreover, aesthetic preferences for a design differ from person to person in essence. Such multimodality complicates the formulation of an optimization problem of whether the human visual perception or aesthetic preference is the objective to be optimized. Due to these difficulties, computational design tools for discrete element layouts are presently limited.

In this thesis, we propose three computational design tools for discrete element layouts. We tackle these problems with reasonable assumptions by making them tractable. In the first method, we focus on a spatial distribution of discrete elements with different appearances. Because it is difficult and tedious for a user with manual operations to distribute different element spatially in a uniform manner, we propose a procedural method to distribute multi-class (different appearances) elements in which the spatial uniformity of the element's distribution is considered as the objective.
In the second method, we focus on a discrete color arrangement, i.e., color palettes, and propose a computational design tool for rating a given palette and suggesting an additional compatible color for the palette. As human color preference differs from person to person or one culture to another, we employ a machine learning approach to address this problem. By customizing a training dataset, we can tailor a model for any color preference and suggest compatible colors to users. Finally, based on a visual cryptography scheme, particularly the secret sharing scheme, we propose a method for generating special patterns that can reveal secret patterns when superimposed on other patterns. The interesting part of our method is that the secret to be decrypted is changed based on the other patterns to be superimposed. We optimized the generated patterns with visual quality as the objective.

We analyzed the proposed methods both quantitatively and qualitatively including user studies. Additionally, we demonstrated various applications of the proposed methods, which show their applicability in broadening areas of discrete element layouts. However, we only cover portions of discrete element layouts. Notably, owing to the abstract nature of the problem, the discrete element layout fields are vast and include many concrete application scenarios. We believe that this thesis is a significant contribution to the advancement of the study of computational design for discrete element layouts.

***Keywords****: Computer Graphics, Computational Design, Discrete Element Layout, Color Palette Design, Visual Cryptography*