Relation-Based Parametrization and Exploration of Shape Collections

Kurt Leimer   Michael Wimmer   Przemyslaw Musialski

TU Wien

Motivation

Large shape collections make it possible to quickly synthesize new shapes by combining parts of existing shapes.
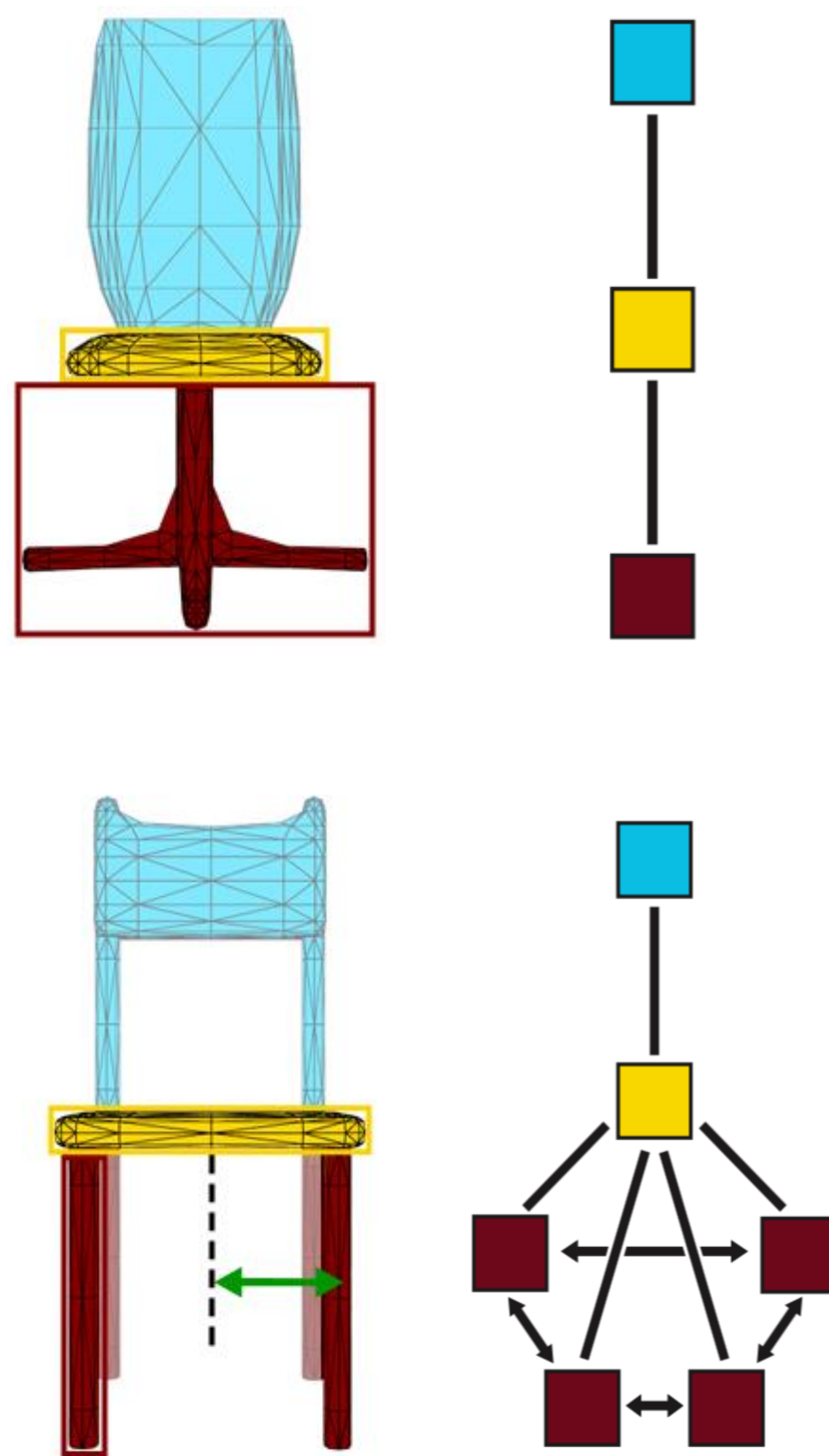
However, exploring large collections in a meaningful way can be a difficult task itself.

Goals

Our goal is to provide an intuitive way of exploring large shape collections, taking into account:

- variability of part arrangements
- different shape structures

Parametrization

The input is a co-segmented set of shapes. For each shape, we first compute a structural graph with adjacencies and symmetries between parts.

For each adjacency edge we compute spatial features like horizontal and vertical distance, angle and relative scale between the adjacent parts.

We embed each set of edges connecting the same types of parts into a feature space and, using PCA, find the directions with the greatest variation. These are then used to form our parameter space for exploration.

Linear vs. Non-Linear

Instead of PCA, we can use non-linear dimensionality reduction methods to better reflect the variation of the shapes.
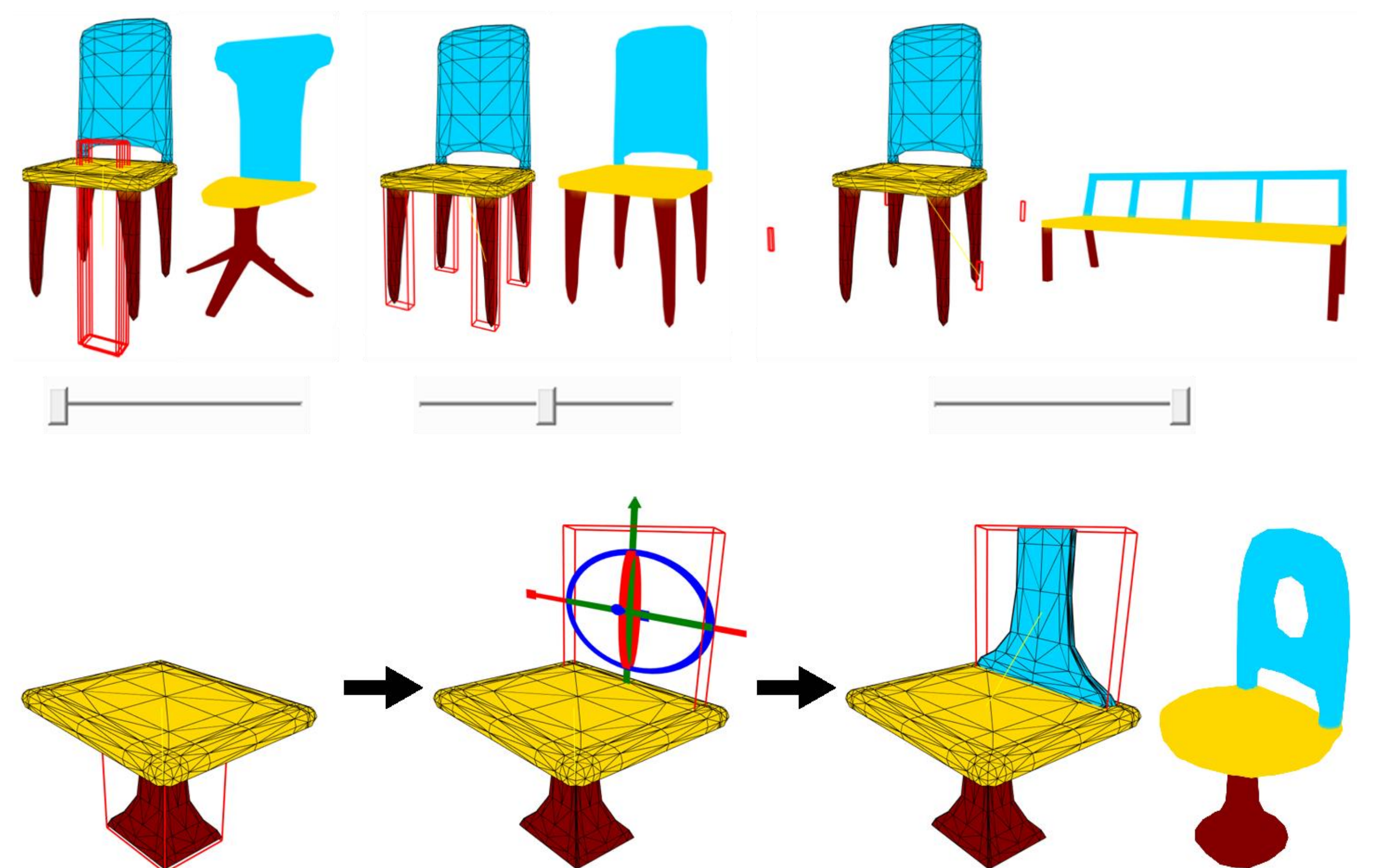
However, this requires additional parameters and the interaction becomes less intuitive.
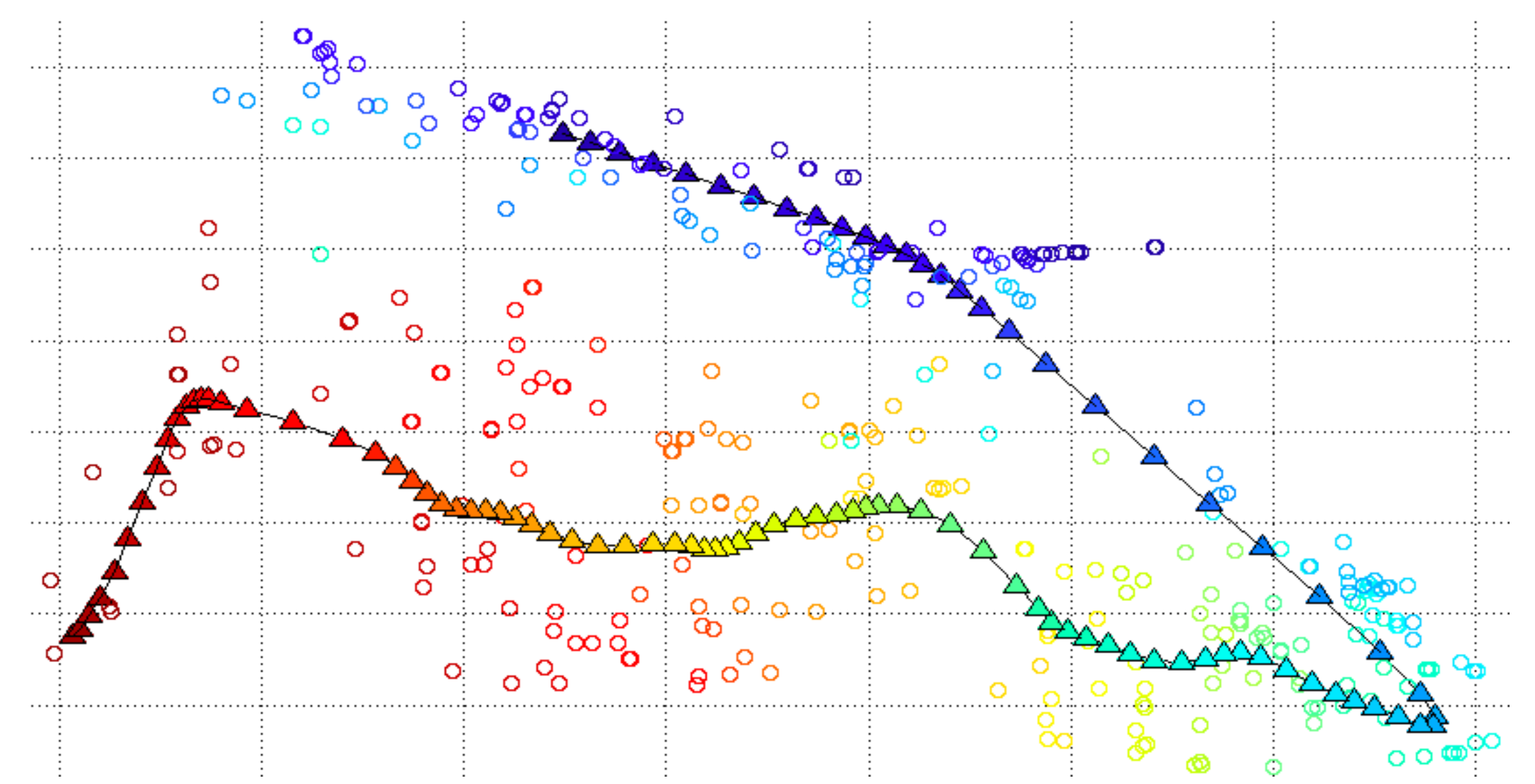
Exploration

We can explore the collection by picking two adjacent parts of an existing shape and altering their exploration parameters, which corresponds to a change in their spatial arrangements. A visual representation of these changes is provided as a way to quickly understand the effects of altering the parameters.

We can also take into account the spatial arrangements between multiple pairs of parts to find shapes with more specific part arrangements. Furthermore, to find shapes with different structures, we can alter the structure of the current shape by copying exisiting parts and assigning it to a different part category.

Results

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