REPRESENTING STYLE BY FEATURE SPACE ARCHETYPES

Description and Emulation of Spatial Styles in an Architectural Context

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Abstract. Style is a broad term that could potentially refer to any features of a work, as well as a fluid concept that is subject to change and disagreement. A similarly flexible method of representing style is proposed based on the idea of an archetype, to which real designs can be compared, and tested with examples of architectural plans. Unlike a fixed, symbolic representation, both the measurements of features that define a style and the selection of those features themselves can be performed by the machine, making it able to generalise a definition automatically from a set of examples.

1. Introduction

At its core, style is what distinguishes one group of works from another. This paper proposes that we can define a style using an archetype, an ideal model comprised of the features that exemplify the style. This concept differs from the description of a type, or category into which particular examples can fall, and from that of a prototype, precedent or case, which are actual instances on which later examples can be modelled. An archetype is something between the two, a generalisation that can not exist materially, yet matches and is compared to many actual instances. This is almost certainly not a real example, but an abstraction made up of only those features necessary to differentiate it from other archetypes.

Many approaches to style are based on explicit symbolic representations (where fixed concepts are mapped to named variables) or rule systems. These can tell us useful things about designs and how they can be made, but are inflexible. They reveal some of the ways we learn about styles pedagogically, but typically fixed, historical ones. By contrast this work proposes a method to automatically derive representations from real examples of design.

It is based on the mapping of design examples in a high dimensional feature space, and uses methods of dimensionality reduction of this space to
yield an archetype that describes the style. This can be used to classify, and
as a measure to generate new designs. The use of a feature space agrees with
our own intuitive ability to evaluate designs as being stylistically nearer or
farther from one another, and is commonly applied in machine learning, in
which a space is constructed in which each dimension is a measurement of a
particular feature, and so each example can be represented as a single point.
The nearest neighbour algorithm (e.g. Duda et al. 2001), for instance,
classifies an unknown example of data by simply measuring its distance to
previously known and labelled examples, or prototypes.

Two innovations are proposed over such existing methods. The first is
that the archetype is a generalisation that combines both the concept of the
ideal example and the particular space in which it is measured. In the nearest
neighbour algorithm, a prototype is a real example of data, and all examples
are measured within the same space. The archetypes presented here are
measured in a lower dimensional space consisting only of the features
relevant to that style, and each archetype may be measured in a different
feature space. The archetype, then, is a point in a feature space consisting of
dimensions in which examples of a particular style are closely clustered, and
examples of other styles are distant. It is comprised of both point and space.

This provides a method for analysis of existing designs, but not synthesis
of new ones. Rule-based definitions can be useful because they can be
followed to produce new designs, whereas a classification algorithm by itself
clearly cannot. The second innovation incorporates the notion of affordances
(Gibson 1979), to consider the design process as a continual evaluation and
choice between possible alternatives as the development of the design
progresses. These choices can be made by repeated measurement against the
ideal that the archetype represents.

The approach was tested within the design domain of architecture, using
the plan in particular. This paper implements the two major aspects of the
approach in Sections 3 and 4. The first deals with analysis, and begins by
providing methods by which plans of real buildings can be embedded in a
feature space such that those that are similar fall near to one another. This
yields a way in which all styles might be understood and represented by a
computer, which is not based on any predefined symbolic representation.
The second part refines this spatial embedding, and combines a very simple
generative process to synthesise designs. An archetype is defined from a set
of examples and used to guide new designs in the same style.

2. Related Techniques

Several techniques from related fields of machine vision and space syntax
are relevant to this work. They are outlined here along with a discussion of
various existing approaches to style.