How to Pick the Right Shape Matching Algorithm for Your CAD Data

Extended Abstract

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Many people are working on shape matching, but there is presently no scientific basis for comparing these many algorithms. The basic premise of this work is that the choice of algorithm will depend on the dataset on which one wishes to perform matching, classification or retrieval. Hence, the fundamental problem it address is *given a domain of 3D models, which algorithm(s) is(are) most suitable?* Even rudimentary sets of objects may be reasonably classified in several different, yet perfectly consistent, ways. Hence, classifications for models are, at least in part, subjective: we assign human labels to 3D models that, when represented only as points and triangles, lack all human-interpretable semantics.

The problem is then to determine what shape comparison algorithm is best suitable in a given context. Our approach is based on concepts from machine learning, statistical learning theory and data mining. The basic approach is to derive, from a 3D pair-wise matching algorithm, a shape classifier and then compare the shape classifiers output against "training data." In this context, the "training data" is a representative set of objects under a target classification. One can then measure the error for a given algorithm with respect to a particular set of data and classification. Comparing two classifiers becomes a manner of computing their relative information gain. The magnitude of the information gain provides a degree of indication about how much better one classifier is than another on the given dataset.

We will present several examples of how to apply this technique using seven different, well known, shape and solid model matching algorithms. We will introduces several novel datasets in the process and discuss the role of these, and other such benchmarks, have to play in helping transition matching techniques to use in the design and manufacturing industries.