

A Comparison Study on 3D Features in Term of Effective Representation for Impression of Shape

Abstract :

Many 3D model databases have been built with increasing emergent technologies such as the 3D printer the opportunity for personal fabrication. These 3D model databases require new tools for indexing, classifying, and retrieving 3D objects, in order to provide the final user an easy and intuitive access to the models.

In this research, we make a comparison study on 3D features in term of effective representation for impression of shape so as to implement of intuitive retrieving. Prior to the comparative experiment in 3D features, professional designer produced 3D models of cosmetic bottle as experimental dataset. To obtain a variety of shapes, 3 bipolar adjectives (“stable-unstable”, “gay-sober”, “soft-hard”) were presented as guidelines for designing shapes. 15 models were produced for each of the adjectives, resulting in a total of 90 models.

Next, we performed classification experiment to compare the effectiveness of representation for impression of shape between three 3D local descriptors: SHOT, FPFH and Spin-Images. For the classification, we used Bag-of-Features (BoF) approach and Support Vector Machine (SVM) as classifier. We determined parameters of BoF by Bayesian Information Criterion (BIC) and SVM by grid search method. Table 1 shows classification results using leave-one-out cross validation. The results suggest that SHOT has stronger linkage with impression of shape than other two descriptors. However, the classification rate was not sufficiently high especially in “stable,” “unstable” and “sober” models. Accordingly, it is necessary to clarify the relation between shape features and impression from the obtained results, and develop a new 3D feature.

Table 1 Classification Rate (%)

Descriptor	“stable”	“unstable”	“soft”	“hard”	“gay”	“sober”	Total
SHOT	20.0	6.7	73.3	80.0	80.0	33.3	48.9
FPFH	20.0	20.0	73.3	73.3	53.3	13.3	42.2
Spin-Images	0.0	6.7	80.0	60.0	73.3	26.7	41.1