SHape REtrieval Contest 2008: CAD Models

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ABSTRACT

This paper presents the summary of all the results of the participants in the event SHREC08 – CAD Model Track.

1 INTRODUCTION

Engineering parts typically have high genus, rounding features (fillets, chamfers), and presence of an internal structure. They are closed watertight volumes. Engineering models can be parts or assemblies. A part is an atomic unit and many parts are assembled to make an assembly. For example, a wheel can be a part whereas a bike is an assembly. Moreover the engineering context is unique where in part families and parametric models, i.e. models differ by relative dimensions of various local geometries, are common. So this track focuses on engineering parts and the search tasks in an engineering context.

2 DATASET

The engineering track uses the Purdue Engineering Shape Benchmark (ESB) [1]. This established database consists of closed triangulated meshes of CAD parts in vendor neutral formats. This dataset is classified into a ground truth classification which has two levels of hierarchy. Overall there are three super-classes with 45 sub-classes under them. This classification can be browsed at http://purdue.edu/shapelab.

3 QUERYSET

The query set was developed to articulate four main search conditions in the engineering context. All the models in the query set except six of them were constructed from the current version of Engineering Shape Benchmark. The search conditions that were considered are:

- **Subdivided/Decimated**: In engineering, the models are mostly stored in proprietary formats containing exact geometry information. Triangulated meshes are generated for neutral format data transfer between vendors or for rapid prototyping applications. Hence the different triangulation parameters for the same model will generate meshes with different sets of triangles. This is equivalent to having a subdivided or decimated mesh with respect to a reference mesh.
- **Parametric Variation**: Typically vendors manufacture classes of parts. A class or family of parts has the same overall shape. The different instances of models in a class are obtained by choosing different values for parameters such as dimensions and constraints. So some portions of the model may be in different sizes and proportions.
- **Slightly modified**: During many instances in typical engineering scenarios the small holes and features in a model are overlooked. Consider a single part being manufactured in three stages and each stage as being handled by different vendors. Then the level of detail of the CAD model they use will vary. The initial stage vendor may have a very coarse model with no holes and other machining features at all. The next stage vendor may machine the major features and the last stage vendor will create the small holes and other finishing effects. So we created models that reflect these situations with minor variation in the shape details.
- **Partial Shape**: Sometimes the user might be interested in a specific portion of the shape of a part. So we altered models by chopping off some portion of the model to create partial shape queries. These may be advanced level tasks for the shape search engines at this time.

  Details regarding individual queries are available at: https://engineering.purdue.edu/PRECISE/shrec08/Shrec08_Results/queryset

Search Type	Queries
Subdivided/Decimated	9
Parametric Variation	10
Slightly modified	10
Partial Shape	4

4 SUBMISSIONS

There were five participants in the CAD models track in SHREC 2008. NIST, USA had two participants – Asim Wagan et al. and Xiaolan Li et al., Thibault Napoleon from ENST-TSI (2 runs), two teams A and B of Ryutarou Ohbuchi et al. from University of Yamanashi. All the runs of all the participants were evaluated as described below.

5 EVALUATION MEASURES

We have evaluated all the performance measures that were used in the SHREC 2006 [1]. The detailed results are available at https://engineering.purdue.edu/PRECISE/shrec08/Shrec08_Results.

Based on the query model condition, the performance can be aggregated and studied for the different search types. From the evaluation for parametric models, it will be interesting to observe the results for the family of parts. We believe that the partial shape queries are advanced level tasks at this point of time. Nevertheless we incorporated a few partial shape queries to get an idea of the current level of performance. There are six models which are totally new and not present in ESB. These models are expected to test the performance of any training that was used. All other queries are very similar to the ones currently existing in ESB.

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6 OVERALL EVALUATION

Figures 1 and 2 plot the overall mean normalized cumulative gains for each run. From the figures, it can be seen that Ohbuchi et al.'s A team performs the overall best among all the submissions. More evaluations for each query are available on the website.

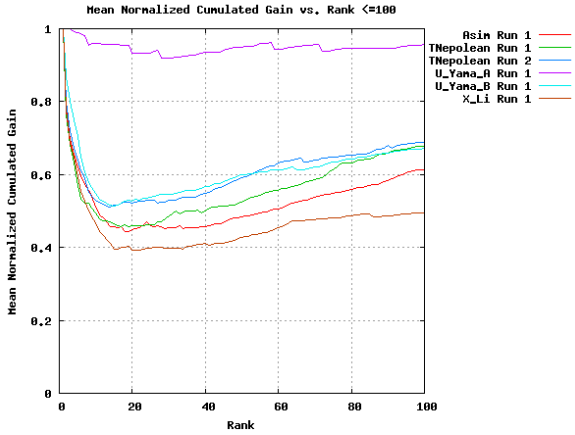

Figure 1. Mean Normalized Cumulated Gain vs. Rank

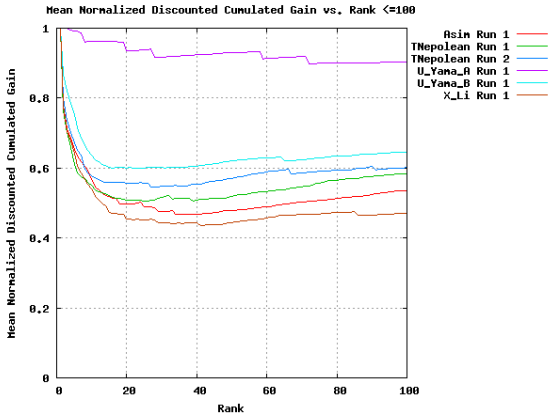

Figure 2. Mean Normalized Discounted Cumulated Gain vs. Rank

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