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SHREC 2009 - Shape Retrieval Contest

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Abstract

The general objective of the 3D Shape Retrieval Contest (see `http://www.aimatshape.net/event/SHREC`) is to evaluate the effectiveness of 3D-shape retrieval algorithms. After three years of success, the contest is now organized in conjunction with the Eurographics Workshop on 3D Object Retrieval, where the evaluation results are presented.

Thanks to the effort of previous track organizers, SHREC already provides many resources to compare and evaluate 3D retrieval methods. For this year's contest, we aimed at new and updated tracks. This time, three track were run: generic shape retrieval, querying with partial 3D models, and structural retrieval of watertight models.

Categories and Subject Descriptors (according to ACM CCS): H.3.3 [Information Storage and Retrieval]: Information Search and Retrieval—, I.3.5 [Computer Graphics]: Computational Geometry and Object Modeling—, I.4 [Image Processing and Computer Vision]: Scene Analysis—, I.5.4 [Pattern Recognition]: Computer Vision—.

1. Introduction

Unlike text documents, 3D models are not easily retrieved. Attempting to find a 3D model using textual annotation and a conventional text-based search engine would not work in many cases. The annotations added by human beings depend on language, culture, age, sex, and other factors. They may be too limited or ambiguous. In contrast, content based 3D shape retrieval methods, that use shape properties of the 3D models to search for similar models, work better than text based methods [MKF04].

3D media retrieval is overlooked in most commercial search engines, while at the same time it is expected to represent a huge amount of traffic and data stored in the Internet. Indeed, geometry is poised to become the fourth wave of digital-multimedia communication, where the first three waves were sound in the 70s, images in the 80s, and video in the 90s. Recent advances in technology have made available cost-effective scanning devices that could not even be imagined a decade ago. It is now possible to acquire 3D data of a physical object in a few seconds and produce a digital model of its geometry that can be easily shared on the Internet. On the other hand, most PCs connected to the Internet are nowadays equipped with high-performance 3D graphics hardware, that support rendering, interaction and processing capabilities from home environments to enterprise scenarios.

TREC, the Text Retrieval Conference [TREa], is a series of workshops on large scale evaluation of text retrieval technology organized since 1992, which has had a major impact on the text retrieval community. Following the successful example of TREC, a number of other competitions have been organized, for example: TRECVID, the TREC Video Retrieval Evaluation [TREb], FRGC, the Face recognition Grand Challenge [FRG], VOC, the Visual Object Classes challenge [VOC], MIREX, the Music Information Retrieval Evaluation Exchange [MIR], INEX, the Initiative for the Evaluation of XML [INE], and FVC, the Fingerprint Verification Competition [FVC].

Since 2006 the 3D Shape Retrieval Contest SHREC has been organized. The general objective is to evaluate the effectiveness of 3D-shape retrieval algorithms. For more information about the organization, see the SHREC home page at `http://www.aimatshape.net/event/SHREC/`. The first year there was only one track, since then there were multiple tracks. For the proceedings of the 2006-08 events, see [VRS*06, VtH07, VtH08].

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2. Tracks

Track organizers take care of the following aspects:

- The particular task. One might ask for a complete or limited ranking, a classification, etc.
- The collection. Is the test set collected or generated. Are there copyright issues? Will it be made public? Is there a classification of the models?
- The queries. How are the queries determined? Are the query models from the collection or new models, or is it just a verbal description, etc.
- The ground truth. Is there a ground truth, is there a relevance scale (highly relevant, marginally relevant, ...), how and when is it determined (based on classification, visual inspection, ...), etc.
- The evaluation method. Which performance measure will be used for the evaluation (precision, recall, nearest neighbor, k-th tier, average dynamic recall, normalized cumulated gain, etc.).
- The procedural aspects. Does every participant perform the queries, or is that done in a central place? Who does the performance assessment? When are test set and queries made available?

Three tracks have were organized this year:

- Generic shape retieval, organized by A. Godil and H. Dutagaci (NIST), see `http://www.itl.nist.gov/iad/vug/sharp/benchmark/shrecGeneric/` and [GDA*09].
- Querying with partial models, organized by H. Dutagaci and A. Godil (NIST) see `http://www.itl.nist.gov/iad/vug/sharp/benchmark/shrecPartial/` and [DGA*09].
- Structural shape retrieval of watertight models, organized by J. Hartveldt (Utrecht University) and M. Spagnuolo (CNR-IMATI), see `http://shrec.ge.imati.cnr.it/SHREC_2009_-_Structural_Shape_Retrieval/Home.html` and [HSA*09].

One other tracks was proposed, 3D retrieval using machine learning, but was not run, due to lack of participants.

3. Discussion

This year there are 9 groups participating in the three tracks. Some groups participated in more than one track with the same method. It is interesting to see their relative performance.

One observation that can be made, is that some of the methods that work well for generic shape retrieval, also work well for in the structural track, although not all methods participated in both tracks.

From the past we know that view based methods have a good performance in general. That can be seen also this year. The view based methods also naturally are suitable for querying with range scans, as is done in the track on querying with partial models.

From the generic shape retrieval track we see a new trend: combination strategies. One can observe that combining scales, pose normalizations, or descriptors in general improves the retrieval performance. Further improvement may be expected by further pushing these strategies.

Note that the papers describing the tracks describe the set-up, the methods, and the results. The methods themselves are not peer reviewed. This serves the purpose of SHREC: to gain insight in which methods works well on which cases, compared to other methods, regardless the novelty or complexity of the methods. To emphasize this special character of these track papers, the titles all start with "SHREC'09 Track".

Acknowledgments

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