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Foreword

Special issue on executable papers for 3D object retrieval ☆

Reproducibility is a cornerstone of scientific research. In computational disciplines, scientific results are often encapsulated in algorithms, devised to process data and produce important results in some innovative manner. Reproducibility is mentioned as a peer-reviewing criterion by many journals and conferences in the field, where it often means "does the manuscript contain enough details to implement an algorithm that produces results similar to those presented?" This special issue addresses reproducibility from different, yet essential, perspectives: "what happens if I change this or that parameter during a run of the algorithm?" or "how do the results change if I try the algorithm on another dataset?"

Interacting with executable code provides an intuitive way to better understand the content of journal papers addressing computational problems: it allows for testing the algorithms under various parameter settings and input data, thereby offering a way to evaluate how well results can be reproduced. In addition to increasing the trustworthiness of the research results, the ability to try out different settings can lead to a better understanding of the techniques, and provide further insights into their effects.

In collaboration with the Editor-in-Chief of *Computers & Graphics*, we present in this special issue the first collection of papers which adopts the approach proposed by the Elsevier *Executable Paper Grand Challenge*. In an "executable paper", authors have the ability to embed chunks of executable code and data into their papers, and readers may execute that code within the framework of the research article. The executable paper combines the narrative of a traditional scholarly paper with embedded computational experiments that run chunks of code on pre-specified or interactively provided datasets, producing verifiable results. Executable papers collected in this special issue rely on the *Collage Authoring Environment*, a workflow and publication platform developed by the first place winner of the 2011 Executable Paper Grand Challenge.[1]

As a theme for this first special issue, we selected 3D Object Retrieval. Content-based 3D retrieval is poised to become crucial in many modern computer graphics applications, such as computer-aided design, game development and film production. Several approaches have been proposed which adopt different methods to evaluate similarity and matching a query shape against objects in the database. Similarity evaluation is a challenging computational task, whose complexity ranges from defining global descriptors to establishing correspondences among parts of different objects.

In this context, we invited contributions in 3D shape analysis, 3D object classification and indexing, 3D object matching, query interfaces and search modalities. Additionally to the traditional textual content, contributions had to contain experiments (i.e., executable code, data, descriptions of the parameters used) to allow interacting with the computational steps described in the manuscript. Submissions were selected based both on traditional scholarly reviewing and also on the extent to which papers used the novel features of the executable paper framework and provided an improved reading experience.

After evaluating 16 initial proposals, ten manuscripts were finally submitted. Following a two-stage review process, which saw at least three reviewers assigned to each manuscript, seven papers were selected for publication. The first paper, *Data-aware 3D Partitioning for Generic Shape Retrieval*, by Sipiran and Bustos [1], introduces a general 3D shape retrieval method, based on signatures that combines a global measures with descriptions defined over mesh partitions. The executable experiment allows the reader to choose between linear and quadratic programming, set parameter values, and choose between descriptors.

The paper *Evaluating 3D Spatial Pyramids for Classifying 3D Shapes*, by Lopez-Sastre et al. [2], focuses on 3D shape categorization, introducing a novel discriminative approach built on quantized 3D local descriptors, organized hierarchically. The executable experiment allows the reader to choose dictionary size, number of pyramid levels, target database, etc.

3D shapes are available in a wide variety of file formats, which poses problems for data search and exchange. The paper *A Flexible and Extensible Approach to Automated CAD/CAM Format Classification*, by Cicirello and Regli [3], addresses this problem by introducing an automated identification of engineering file formats without a priori knowledge about the nature of the physical file object. The executable experiments enable the reader to interactively generate and visualize the precision–recall curves, to provide own test sets, and use variations of the classifier.

Recent hardware technologies have enabled acquisition of 3D point clouds from real world scenes in real time, but most processing techniques to handle these point clouds are computationally intensive, especially when real time performance is required. The paper *Efficient 3D object recognition using foveated point clouds*, by Rocha et al. [4], proposes a multi resolution technique that can be used to identify objects in point clouds with efficient timing. The experiments in this paper are concerning segmenting and extracting the object's point cloud, and object recognition with the foveated approach.

For a specific type of 3D objects, the paper *Matching 3D Face Scans using Interest Points and Local Histogram Descriptors*, by

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[1] http://www.executablepapers.com.

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Berretti et al. [5], addresses 3D face recognition in the presence of probe scans with missing parts. They distinguish face traits using 3D keypoints, and then measure how the face surface changes in the keypoints' neighborhood using local shape descriptors. The accompanying experiments demonstrate keypoint extraction, local descriptors, and matching.

The so-called Laplace–Beltrami operator has become popular for shape segmentation and finding correspondences. The paper *An Interactive Analysis of Harmonic and Diffusion Equations on Discrete 3D Shapes* by Patanè et al. [6] studies the various choices for discretization of the operator, and the resulting properties of the solutions. The reader can experiment with different parameter settings and choices.

For approximately isometric meshes, the paper *Landmark Transfer with Minimal Graph* by Mykhalchuk et al. [7] presents an algorithm for landmark transfer. Given landmarks on one mesh, it finds corresponding landmarks on target meshes. The experiments let the reader position landmarks on one mesh, and visualize the transferred landmarks on the other mesh.

Because of the extraordinary character of this special issue, all its papers are accessible to the public through an open access policy via ScienceDirect, Elsevier's leading full text scientific database. The experiments are shown with the article on ScienceDirect to provide for a seamless viewing experience.

Preparing this special issue was a long and complex process, with contributions from several actors. First of all, we would like to thank all authors: preparing an executable paper required thinking carefully what portion of their code was deemed interesting to propose for an interactive reading. For some, this effort required re-structuring of the code in order to prepare the experiments and interactions with the Collage development team. Similarly, we would like to thank all the reviewers of the special issues, who were asked to review the experiments and comment on their efficacy to demonstrate the techniques presented in the manuscripts. The Collage team not only developed the experimentation platform, they were also invaluable in helping the authors preparing the experiments, and helping the guest editors and reviewers with support. The Elsevier staff involved in the preparation of the special issue provided invaluable contributions at all stages of the production pipeline, ensuring proper support, suggestions and taking care of the planning of additional technical developments to the Collage platform. The effort per paper ratio for this special issue is very high, and we hope you enjoy reading and "executing" the papers.

The special issue is a demonstration of how technology may enhance scientific publishing: it is a first attempt, which may be improved in various ways. But we are convinced about the value of this first trial and hope it will foster the adoption of this publishing modality. The usefulness of reproducible research to the scientific community is widely accepted, yet, there is support to state that reproducible research is good for the authors. A number of studies have shown a correlation between sharing data can increase the citation rate [8,9]. This is encouraging, and supports our case for making data and code available.

Moreover, in Computer Graphics research, results are demonstrated by non-trivial software code and, frequently, researchers who need to compare their results with existing ones are facing the problem of trying to implement the algorithms of others and use these implementations to validate their results. The validation may be biased by several factors and there is no way to assess in a valid manner the reproducibility of different algorithms on different datasets. We hope that the spread of this publishing modality will alleviate this problem and give researchers a support also for the comparison of their results.

Last, but definitely not least, our thanks to the Editor-in-Chief, Prof Joaquim Jorge, for his proposal to our undertaking this challenge and his continuous encouragement, pushing, and pulling, in preparing this issue.

References

[1] Sipiran Ivan, Bustos Benjamin, Schreck Tobias. Data-aware 3D partitioning for generic shape retrieval. Comput Graphics 2013;37(5):460–72.
[2] Lopez-Sastre Roberto J, García-Fuertes Alberto, Redondo-Cabrera Carolina, Acevedo-Rodríguez Francisco J, Maldonado-Bascón Saturnino. Evaluating 3D spatial pyramids for classifying 3D shapes. Comput Graphics 2013;37(5):473–483.
[3] Cicirello Vincent A, Regli William C. A flexible and extensible approach to automated CAD/CAM format classification. Comput Graphics 2013;37(5):484–495.
[4] Beserra Rafael, Silva Bruno, Rocha Lourena, Aroca Rafael, Velho Luiz, Gonçalves Luiz M. Efficient 3D object recognition using foveated point clouds. Comput Graphics 2013;37(5):496–508.
[5] Berretti Stefano, Werghi Naoufel, del Bimbo Alberto, Pala Pietro. Matching 3D face scans using interest points and local histogram descriptors. Comput Graphics 2013;37(5):509–25.
[6] Patanè Giuseppe, Spagnuolo Michela. An interactive analysis of harmonic and diffusion equations on discrete 3D shapes. Comput Graphics 2013;37(5):526–538.
[7] Mykhalchuk Vasyl, Cordier Frederic, Seo Hyewon. Landmark transfer with minimal graph. Comput Graphics 2013;37(5):539–52.
[8] Piwowar HA, Day RS, Fridsma DB. Sharing detailed research data is associated with increased citation rate. PLoS ONE 2007;2(3):e308, http://www.plosone.org/article/info:doi%2F10.1371%2Fjournal.pone.0000308.
[9] Henneken Edwin A, Accomazzi Alberto. Linking to data—effect on citation rates in astronomy. arXiv:1111.3618v1 [cs.DL] 15 Nov 2011, http://arxiv.org/pdf/1111.3618v1.pdf.

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