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GMP2021 - 15th International Conference on Geometric Modeling and Processing

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Abstract

This foreword provides an overview of the contributions presented at the fifteenth International Conference on Geometric Modeling and Processing (GMP2021 - May 10-13, 2021).

Keywords: Computer-Aided Geometric Design; Computational Geometry; Geometric and Solid Modeling; Curve, Surface and Volume Representation; Deep learning

1. Introduction

This special issue is related to the 15th edition of the annual international conference series identified by the acronym GMP, which was born with the main goal of bringing together researchers working on both mathematical, computational and applied aspects of geometric modeling and processing.

The modeling and processing of geometric data is fundamental to many computer applications including computer graphics, computer vision, CAD/CAM, medical imaging, engineering analysis, robotics, additive manufacturing and scientific computing.

As trends and methodologies in geometry continue to evolve, GMP continues to provide a premier venue for sharing work that advances cutting-edge, creative and rigorous techniques for geometric modeling and processing.

The attendees of the GMP conference series find in this event a forum for exchanging new ideas, discussing new applications, presenting new solutions and have also the opportunity to here establish new collaborations that give rise to new research projects.

The 2021 GMP conference was planned to be in Pilsen (Czech Republic), but changed into virtual meeting because of the enduring diffusion of COVID-19. The same happened with GMP2020, originally planned to be in Okinawa, but then changed into virtual meeting and successfully held online. Conversely, all previous GMP conferences were held in presence and took place in a wide variety of locations: Vancouver (2019), Aachen (2018), Xiamen (2017), San Antonio (2016), etc.

2. Topics of the special issue

The papers in this special issue belong to a selected collection of contributions that passed the strict peer review process of this conference series.

In the following we provide a short overview of the specific topics covered by these contributions, emphasizing also the new emerging research themes.

Most of the papers collected in the special issue are related to the central topic of curve, surface and volume representation.

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In particular, in the curve setting, Tong and Chen (2021) deal with 3D typical curves (a class of spatial, special Bézier curves featured by monotone curvature and torsion), and introduce a new sufficient condition that corrects Farin’s result.

In the surface setting, Lipschütz et al. (2021) propose algorithms for the generation of surface coverings by single-sized spheres, Thayyil et al. (2021) introduce a feature preserving surface reconstruction algorithm to produce a high fidelity triangulated mesh from an input point set, Karčiauskas and Peters (2021) present a construction that unifies the traditionally different approaches proposed for bicubic C^2 -splines and biquadratic C^1 -splines to fill n -sided holes by a tiny central G^1 cap, and finally López Ureña and Viscardi (2021) discuss a general strategy (that exploits annihilating operators) to locally detect if the given input data are sampled from a certain bivariate exponential polynomial and choose, accordingly, the correct subdivision rules for reconstructing it via a level-dependent subdivision scheme.

In the volume setting, Peltier et al. (2021) present a volume parametric model computed from a piecewise smooth skeleton and Masalha et al. (2021) introduce several algorithms for the construction of, possibly heterogeneous, trivariate fillets, that support smooth filleting operations between pairs of, possibly heterogeneous, input trivariates.

Other works in this issue propose algorithms for solving computational geometry problems such as computing the precise Hausdorff distance between two freeform surfaces (Son et al. (2021)) or the self-intersection of a freeform surface (Park et al. (2021)).

Some other works presented this year at GMP are driven by advances in machine learning, one of the most trendy topics of the moment. In particular, they include learning techniques for image segmentation based on combining implicit spline representations with deep convolutional neural networks (Barrowclough et al. (2021)), a multi-derivative physical and geometric embedding network for action recognition from skeleton data (Yan et al. (2021)), and a dilated silhouette convolutional network for action recognition from a monocular video (Hua et al. (2021)).

The remaining papers deal with the generation of planar maps and parameterizations. Specifically, Wang et al. (2021) deal with the construction of quadratic birational planar maps, Groiss et al. (2021) present a particularly simple geometric derivation of Tutte’s theorem for plane near-triangulations and various extensions, Yuan et al. (2021) introduce a novel method to compute bijective domain parameterizations with low distortion for use in isogeometric analysis, and Trautner et al. (2021) propose and analyze a generalization of polar parameterizations of star-shaped domains, which uses parabolic arcs instead of lines or circular arcs. Finally, Scholz and Jüttler (2021) deal with the problem of finding the optimal parameterization for fitting a given sequence of data points with a parametric curve with the help of a residual neural network.

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