From the Topical Issue Editor

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Welcome to the topical issue of 3D RESEARCH on 3D Research and Technologies for Mechanical Engineering and Industrial Design.

The present Topical Issue is devoted to “3D Research and Technologies for Mechanical Engineering and Industrial Design”, and it tries to reflect what one reads in the text “Message from the Editor-in-Chief” (found on the web site of this journal): “3D is where disciplines merge and where they diverge into a remarkable range of applications from entertainment to health care that touch, or will soon touch, the lives of millions”. Indeed, Mechanical/Industrial Design has been, since the early days of Ivan Sutherland’s “Sketchpad” research (1963), the principal area of application for 2D/3D Computer Graphics, Computer-Aided Geometric Modeling, Human-Computer Interaction, Virtual Reality, and Advanced 3D Visualization. This relationship between Mechanical/Industrial Design and 3D Technologies has always been “bidirectional” with researchers in Mechanical/Industrial Design (and in related fields like Civil, Aerospace, Automotive, and Manufacturing Engineering) significantly contributing to 3D modeling and 3D processing. This topical issue features articles by engineering researchers covering both “general-purpose 3D” as well as “3D for Mechanical/Industrial Design”:

The paper by Fen FANG and Yong Tsui LEE deals with “sketch-based 3D geometric modeling” and focuses on the classical problem of algorithmically deriving 3D geometric information from a single line-drawing. The authors analyze the version of this problem dealing with a perspective drawing, and propose an efficient solution with linear complexity. The paper by Gernot FRENER et al. is in the area of Automobile Design/Manufacturing and

focuses on a sub-problem (: automated generation of PVC-seams for corrosion protection of sheet metal components) that demands a solution minimizing user involvement. The authors highlight the geometric complexities involved in this problem, and describe a robust solution combining sophisticated “curvature analysis” of 3D curves/surfaces with knowledge-based functionalities of modern computer-aided design (CAD) systems. This solution has already been implemented and tested in an industrial CAD system supporting virtual assembly of automotive parts in digital mock-ups.

The contribution by Luoting FU et al. deals with 3D surface modeling for “creative Industrial Design”. The present research is built upon “Laplacian Surface Editing”, which is drastically improved to accommodate various forms of design constraints. The proposed surface-editing method is implemented in a prototype which is applied in three “design scenarios”, demonstrating appropriateness of the underlying algorithms for “Direct Modeling” of shapes in Industrial Design.

Shape Interrogation of 3D surfaces is vital for many specialties in Mechanical/Industrial Design. The paper by Yuji KOBASHI et al. extends sophisticated surface interrogation tools (e.g., reflection lines, highlight lines, geodesics, geodesic offsets, lines of curvature, etc), originally developed for analytic B-spline surfaces, to surfaces represented by triangular meshes. In particular, the authors present (a) a unifying technique for reusing the shape interrogation tools developed for B-splines also for a triangular mesh without any change in the original algorithms, and (b) a novel approach to parameterize a piecewise linear triangular mesh as a set of graph triangular Bézier patches.

Mechanical engineers have long been involved in research aiming at 3D models of parts of the human skeletal system simulating bio-mechanical response, to support medical applications like medical device and implant design/development, optimization of surgical procedures, etc. The paper by Alexander TSOUKNIDAS et al. uses 3D images based on Computer Tomography (CT) or Magnetic Resonance Imaging (MRI) and methods determining bone material properties to construct accurate 3D finite-element anatomical models. This work focuses on modeling a Functional Spinal Unit using advanced finite-

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element technology and sophisticated “meshing” techniques. The proposed models are fully validated on the basis of various experiments and simulations.

The concluding paper in this “topical issue”, authored by Nikolaos C. GABRIELIDES revisits a classical problem in mechanical CAD and 3D geometric modeling: Construction of 3D shape-preserving spline curves. First, “shape preservation” is analyzed, and then an improved curve construction method is introduced possessing this property. The paper also discusses a prototype implementation of the proposed method, which is validated on the basis of “curvature criteria” in the context of ship-hull design.

I hope that this collection of articles will fully justify our claim that there is a permanent bond between Mechanical/Industrial Design & Engineering and 3D

Technologies, and that from the related research also other fields benefit, like Computer Science, Mathematics, Architecture, Medicine, Education, the Fine Arts, and the Entertainment Industry.

I would like to express my deep appreciation (a) to the excellent referees of this issue (especially those who are not among the authors of this issue), whose constructive comments significantly improved most of these papers, and (b) to Professor Jihoon Lee (Managing Editor of “3D Research”) and to the staff of “3D Research” for their great help and support.

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