6th European Conference on Computational Mechanics (ECCM 6)
7th European Conference on Computational Fluid Dynamics (ECFD 7)
11 15 June 2018, Glasgow, UK

# REAL-TIME SIMULATION, VISUALISATION AND IMAGE PROCESSING IN ENGINEERING SCIENCE

## A joint symposium on Image Processing and Virtual Engineering

Abstracts for both themes overleaf

6th European Conference on Computational Mechanics (Solids, Structures and Coupled Problems) (ECCM 6)
7th European Conference on Computational Fluid Dynamics (ECFD 7)
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# IMAGE PROCESSING AND VISUALIZATION

**JOÃO MANUEL R.S. TAVARES[*], RENATO NATAL JORGE[*] AND YONGJIE JESSICA ZHANG[†]**

[*] Faculdade de Engenharia da Universidade do Porto
Rua Dr Roberto Frias s/n, 4200-465 Porto, Portugal
tavares@fe.up.pt, rnatal@fe.up.pt, www.fe.up.pt/~tavares

[†] Carnegie Mellon University
318 Scaife Hall, 5000 Forbes Avenue, Pittsburgh, PA 15213, USA
jessicaz@andrew.cmu.edu, www.andrew.cmu.edu/user/jessicaz

**Key words:** Image Analysis, Data Processing, Scientific Visualization, Virtual Reality.

## ABSTRACT

Image Processing and Visualization are among the most active areas of research of the past few decades. Justification of this activity arises from the requirements of important practical applications such as the visualization of computational mechanics data, the processing of medical images for assisting medical diagnosis and intervention, and the analysis of motion for sports training. Currently, due to the development of mathematical and physical methods, researchers have been incorporating advanced computational techniques into image models to derive sophisticated algorithms that can better solve the problems encountered. Many effective methods have been proposed. Some of them have already been integrated into commercial software.

The main goal of the proposed symposium is to provide a platform for communications among specialists from complementary fields such as mechanics, computational vision, mathematics, informatics, computer graphics, psychology and industry. Participants in this symposium should present and discuss their proposed methods in the corresponding fields that are related to the symposium topics. This symposium should be a good opportunity for them to refine their ideas for future work and to establish possible cooperation.

Another important objective of the proposed symposium is to establish a connection between researchers and end-users from diverse fields.

Topics of interest include (but are not restricted to) the following: Image Analysis; Image Restoration, Compression, Segmentation and Description; Object Tracking, Matching, Recognition, and Reconstruction; Visual Inspection; 3D Vision; Medical Imaging; Scientific Visualization; Enhanced Visualization; Human Computer Interaction; Virtual Reality; Simulation and Animation; Data Processing, Modeling and Analysis; Numerical Methods, Partial Differential Equations, Level-sets, Meshless and Extended or Enriched Finite Element in Image Processing and Visualization; Multifields and Multiphysics Problems involving Image Processing and Visualization; Software Development for Image Processing and Visualization; Grid Computing in Image Processing and Visualization; Applications of Image Processing and Visualization.

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# TOWARDS A REAL-TIME MODELLING AND SIMULATION PLATFORM FOR VIRTUAL ENGINEERING DESIGN AND ANALYSIS

**Adrian R. G. Harwood[1], Petra Wenisch[2] and Alistair J. Revell[1]**

[1]School of Mechanical, Aerospace & Civil Engineering
The University of Manchester, Oxford Road, Manchester, M13 9PL, UK
adrian.harwood@manchester.ac.uk

[2] Univerity of applied Sciences Potsdam, Faculty of Civil Engineering
Kiepenheuerallee 5, 14469 Potsdam, Germany
wenisch@fh-potsdam.de, www.fh-potsdam.de

**Key words:** *Unreal Engine, Android Mobile Devices, GPU Computing, Lattice-Boltzmann Method, Virtual Reality*

The ability to perform credible CFD simulations at highly-accelerated speeds has opened up the potential for a new use-mode for CFD as a tool in engineering: the application of CFD for parameter-space exploration, analysis and design communication. When coupled with a suitable real-time rendering and interaction capability for in-situ visualisation and manipulation of 3D results, CFD may be used as part of an interactive design tool in virtual engineering. These steerable applications represent a paradigm shift in the application of CFD for engineering and offer the potential to transform the way CFD is used within the industry.

This article presents various advancements towards a production-ready virtual wind tunnel including presentation of an integrated, interactive modelling and simulation tool for aerodynamic design and analysis built using the Unreal Engine 4 game engine. The virtual wind tunnel application provides a mechanism for integrating virtual reality observation, navigation, visualisation and in-game interaction with a flow field simulated using our own GPU-accelerated CFD library based on the lattice-Boltzmann method. Objects may be imported from CAD or reconstructed using Microsoft Kinect-based 3D scanning. Simulation parameters may be modified at run-time by the user.

The flow solver has been validated against experimental data for a representative turbulent flow and demonstrates excellent agreement with available data.