# Editorial

Pier Paolo Valentini

Department of Mechanical Engineering,
University of Rome 'Tor Vergata',
00133 Rome, Italy
Fax: +39 06 2021 351
E-mail: valentini@ing.uniroma2.it

**Biographical notes:** Pier Paolo Valentini (Laurea in Mechanical Engineering in 2000, PhD in Design of Mechanical System in 2004) is a researcher at University of Rome 'Tor Vergata'. He teaches Mechanical Design courses at the Faculty of Engineering. His fields of research focus on virtual engineering, simulation of mechanical systems, tolerance allocation and biomechanics. He is author or co-author of more than 80 scientific papers and books. He has been the principal investigator of many research projects funded by academic institutions and industries.

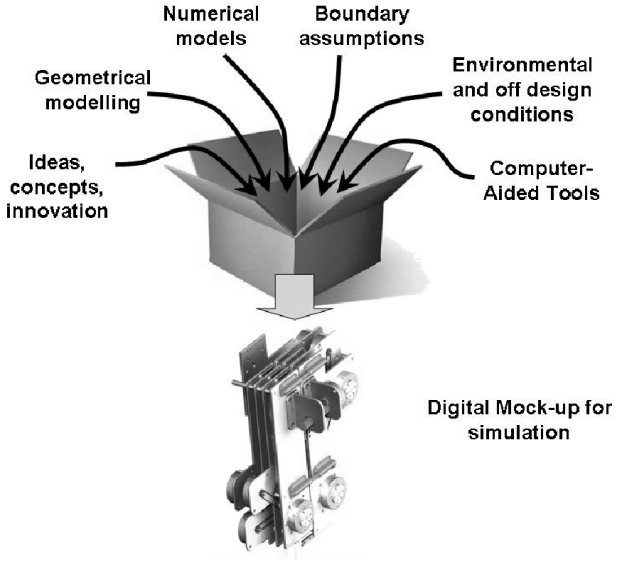
During the last decade, the role of computational virtual tools has reached a significant level. Today, there is not any innovative industrial product or technology that goes to the market without being touched by computer-aided tools. The role of *simulation* has become essential for a competitive design, optimising complex procedures, improving performance, reliability and safety. Behind the simple word *simulation*, there are a huge number of computer-aided instruments. They range from modelling tools (CAD) to structural solvers (FEM, BEM, etc…), motion solvers (Multibody), fluid-dynamics solvers (CFD), up to virtual or augmented reality environment. All these contribute to assist the designer in his difficult tasks and to support his decisions.

Thanks to the availability of high-performance computer hardware, virtual computations can simulate the actual behaviour of industrial systems with a high level of realism, accuracy and reliability.

One of the most difficult tasks in building a virtual model for simulation is to observe the real word and address the boundary assumptions to a mathematical or numerical model. Even an accurate implementation can produce wrong results if these conditions are incorrect or incomplete. Moreover, the main issue for a competitive and reliable design is the robustness of the product with respect to small changes of boundary assumptions. The variability of these parameters is often called *off-design condition*.

A smart designer has to consider off-design parameters and evaluate their sensitivity on global performances. He needs to find the right answer to the question "What happens if …?". The choice of off-design parameters to be included in the simulation (i.e., the completion of the phrase) is not an easy task as well. The designer has to deeply investigate physical phenomena, introduce the adequate simplifications and understand the crucial points to be taken into account. Obviously, an important role is played by the individual practice. This can make the difference. All these personal skills have to be supported by adequate and up-to-date computational instruments and methodologies. For this purpose, the virtual simulation of a physical system is more complex than that of an ideal one and requires a wider point of view, including multi-disciplinary thinking and a higher computational effort. For this purpose, computer-aided design researchers have so much to offer to the field of virtual simulation with off-design scenarios, thanks to flexible, modular and integrated approaches (Figure 1).

**Figure 1** Ingredients for building a virtual model




The industrial design can be reviewed as a recipe, the designer has in mind the taste (what the system has to do) and the final outcome (how the system looks like). He has to mix the ingredients in the right way. For this purpose, he has to choose both the kinds and their doses. Right ingredients but wrong doses will produce an uneatable dish (an unsuccessful product). Moreover, a smart designer has to evaluate what happens if the doses are slightly different from the original recipe. The inaccuracy in using the right doses is unavoidable due to the nature of things.

In a mechanical system, it may be due to the presence of changes in environmental conditions, geometry defects, approximations, manufacturing precision, assembling inaccuracy, decaying, wear, etc… Virtual engineers offer powerful instruments to simulate the effect of these real conditions. Owing to their significant number, there is an increasing need of specific tools and the research fields are so wide. The motivation and objectives of this special issue come from all these observations.

The eight papers included in this special issue of *International Journal of Computer Applications in Technology* focus on some of these aspects and propose innovative methodologies and applications for facing such problems. Research topics range from manufacturing errors synthesis and analysis to assembly errors control, to human–computer interaction optimisation, to simulation of complex machining procedures.

It is an honour and a pleasure to serve as guest editor of this issue. I thank the editors of the journal for this opportunity and for their foresight in selecting the specific topic for this special edition.

All the investigations, although originated from academic world, discuss and implement methodologies and approaches, which are feasible and useful for industry.

The variety and worldwide importance of possible applications of virtual engineering in studying off-design conditions is witnessed not only by the different topics addressed by the authors, but also by their geographic origin.

Finally, I wish to acknowledge the fine work of the referees who assisted the screening process.

Thank you for reading this special issue.