Preface

Machine building, and mechanical engineering and design are undergoing rapid change due to fast progress in computational engineering and design, introduction of new manufacturing methods, and increasing intelligence of machines and machine systems. In fact, the whole paradigm of designing components and machines seems to be evolving. In the midst of this fast progress it is sometimes difficult to keep in mind that the fundamental components of machine building still remain. Engineers and designers have to master the physical phenomena involved in their machine applications, even if the phenomena are studied with sophisticated computational tools. Novel theories and supporting computational methods are needed to overcome the challenges in machines and components, which can lead to increased efficiency, power density and an overall increase in machine performance. Meanwhile the engineering and design process for components and machines is shortening, which requires improvements both in engineering and design software applications as well as in the engineering and design process itself. The one who masters the whole engineering and design field best and has streamlined the processes has a clear business advantage.

Tekes – the Finnish Funding Agency for Innovation funded two parallel research projects, SIMPRO (August 2012 – October 2016) and SCarFace (August 2012 – June 2015). The SIMPRO project focused on computational product process starting from computational methods, infrastructure and facilities, and reaching towards a simulation-based product lifecycle process. At the same time, the SCarFace project tackled the theory and modelling of fretting corrosion phenomenon, which is a difficult challenge in machines with high performance, advanced materials and cyclic loading. In both projects, modelling and simulation played a central role in research, engineering and design.

This is a special issue of the Journal of Structural Mechanics, focusing on some of the topics studied in the two research projects mentioned above. The selected articles represent different topics of the projects: method development for the simulation of acoustics, modelling of fretting phenomenon, applying nature-inspired computing for the optimisation of electric machine design, and using surrogate-model based approach in design optimisation.

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