Editorial

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Biographical notes: Christos Spitas is a Professor of Machine Design at Nazarbayev University, where he is active in research and technology development in the fields of geared powertrains, actuators, sensors and smart and durable multi-scale structures and materials, in the context of lifecycle design, including ageing. He is one of the founding members of the Ageing Centre for Structures and Materials at the Delft University of Technology, where he previously held the Chair of Embodiment Design. Prior and in parallel to his academic career, he has held different specialist and managerial positions in the industry in the fields of power electronics, defence, and precision engineering, developing systems and technologies for clients such as CERN and a number of aerospace and automotive companies.

In most technological fields where active research and development is taking place, the driving force is usually some improvement in efficiency, durability and cost. Geared powertrains are no different. The caveat is that durability and cost are fundamentally antagonistic: e.g., to increase durability an obvious solution is to increase size (typically via the module size factor) and correspondingly weight, but this will increase cost-particularly in a mass production setting, where material usage is the dominant cost factor. Often the powertrains are integrated in vehicles, where increased weight leads to higher operating expenditures. Thus, is geared powertrains compactness/power density in the form of power-to-weight ratio or power-to-volume ratio becomes a critical design consideration.

And if size may not be tampered with as such, this means that the many other design parameters ranging from topology to geometry to material must be manipulated creatively to produce non-obvious and interesting solutions at the component level and the system level. With several design parameters and multi-parametric features per gear (module, pressure angle, addendum, dedendum, root, flank definition, asymmetry, width, helix, profile modifications/relief, material, heat/surface treatment, etcetera), gear design is rife with opportunity and still not sufficiently understood.

There is still much to study in order to transition from metal to high performance lightweight plastic and this area is under constant study in the industry and at universities, including durability and transmission characteristics of injection moulded polymer gears. The relationship between gear tooth geometry, durability and dynamics is another persistent topic of research, where the implications of a multitude of design interventions using modified and asymmetric tooth forms still must be understood. Improved passive properties of geared powertrains could further be augmented with sensing and monitoring systems, to produce high reliability systems with maximum usage of remaining life, optimal planning of maintenance intervals and reduced operating expenditures. Furthermore, the effects of errors and misalignments require increasingly sophisticated testing rigs, able to reproduce and test 'in the loop' realistic operating conditions with dynamical and variable misalignments.

These are the topics addressed by the articles in this special issue, which hopes to initiate a focused discussion on the topic and stimulate further contributions: By and large, the last word on high power density geared powertrain design has not been said.