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*Editorial*

# Guest Editorial: Special Issue "Axisymmetry in Mechanical Engineering"

**Emanuel Willert**

Institute of Applied Mechanics, Technische Universität Berlin, Straße des 17. Juni 135, 10623 Berlin, Germany; e.willert@tu-berlin.de; Tel.: +49-30-314-21494

Axisymmetric (or almost axisymmetric) systems are ever-present in mechanical engineering. Axial symmetry enables free rotation, rolling and avoids field singularities at sharp corners. Spheres minimize the ratio of surface area to volume. Rotational symmetry (inherent to the system or enforced externally by the modelling) significantly simplifies the exact or numerical analysis of a model or, in some cases, only allows it in the first place. This list could go on; in fact, registering all the properties and applications of axisymmetry in technical or biotechnological systems would be quite an overwhelming task.

The topic of this Special Issue is thus very broad and, at the same time, very specific. Broad, because axisymmetry is ubiquitous in mechanical engineering, and specific, because it is a very particular mathematical and/or physical concept. This apparent disparity of thematic broadness and narrowness adds a special charm to the Special Issue, as the readers might discover similar specific methods and techniques in very different contexts, and apply them to yet again very different classes of problems—which has always been one of the main propellers of scientific discovery.

This Special Issue consists of five original research articles and one correction.

It opens with the original research paper "A Simple Semi-Analytic Contact Mechanical Model for Tangential and Torsional Fretting Wear of Axisymmetric Contacts" [1]. In this paper, the rotational symmetry of the problem allows for an asymptotic closed-form solution of the contact problem in each fretting oscillating cycle if the wear process is slow compared to the oscillation. In the case of wear laws, which explicitly relate the local wear intensities to contact stresses and relative surface displacements, this leads to a simple integro-differential equation for the wear contact problem. The model can be extended to incorporate the analysis of subsurface stress fields and associated initiation of fatigue cracks.

In the paper "Coaxiality Optimization Analysis of Plastic Injection Molded Barrel of Bilateral Telecentric Lens" [2] the authors study the optimization of process parameters for the injection moulding of cylindrical plastic lens barrels for bilateral telecentric lenses, based on the Taguchi method.

The original research article "An Approximate Solution for the Contact Problem of Profiles Slightly Deviating from Axial Symmetry" [3] provides an asymptotic closed-form solution for the normal contact problem of convex profiles that are almost axisymmetric. Thereby, the term "almost axisymmetric" also applies to profiles which one would not immediately associate with rotational symmetry, e.g., a pyramid with a square base. In this sense, the presented solution can be understood as a general (asymptotic) solution for arbitrary convex contact profiles.

Another important contact mechanical problem is studied in the research paper "A Comparison of General Solutions to the Non-Axisymmetric Frictionless Contact Problem with a Circular Area of Contact: When the Symmetry Does Not Matter" [4]. In the paper, the contact area is assumed to be fixed and circular, e.g., by using a cylindrical rigid punch for the indentation procedure, but the profile of the punch is arbitrary. Thus, one might say, that the contact problem for arbitrary convex profiles is "tackled from another side" through the lens of axial symmetry. The paper presents a deep comparative review

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of known closed-form and series solutions for the described contact problem and gives novel results for the pressure in the contact centre, as well as for the stress intensity factor at the contact boundary, which, among others, is important for the corresponding adhesive problem.

This Special Issue closes with the original research article "Using Cylindrical and Spherical Symmetries in Numerical Simulations of Quasi-Infinite Mechanical Systems" [5]. In this article, rotational symmetry is used as a tool to effectively remove simulation space boundaries—and, therefore, the corresponding artificial boundary effects—for the efficient numerical simulation of long-range interactions in general discrete periodic systems. Specifically, the mantle of a cylinder has no boundaries in the circumferential direction, while the surface of a sphere is boundary-free in all angular directions. As a very interesting example, the authors consider the tectonic dynamics of the earth's continents.

Finally, the correction [6] remediates misprints in the aforementioned original publication [3].

The authors who contributed to the Special Issue and the Guest Editor are hopeful that the published research here will facilitate a better understanding of the challenges and opportunities connected to axial (or other classes of) symmetry in different theoretical or applied branches of mechanical engineering.

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