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BOOK REVIEW

Generation of Surfaces: *Kinematic Geometry of Surface Machining* by Stephen P. Radzevich, CRC Press, Taylor & Francis Group, Boca Raton 2014, xl + 698 pp., ISBN 978-1-4822-2211-1.

The book *Generation of Surfaces*: *Kinematic Geometry of Surface Machining* is aimed to provide an extensive and comprehensive survey on the modern theory of part surface generation with a focus on kinematic geometry of part surface machining on a multiaxis numerical control (NC) machine. It presents the key methods for applying the differential geometry/kinematics (DG/K)-based approach to part surface generation – an extremely powerful tool for solving challenging problems in mechanical/manufacturing engineering. Although the orientation of this monograph is toward computer-aided design (CAD) and computer-aided machining (CAM), it is also useful for solving problems concerning the generation of part surfaces on machine tools of conventional design. The book is intended to be used by mechanical and manufacturing engineers, researchers who are active in the field of the geometry of sculptured part surfaces and kinematics of part surface generation, and senior undergraduate and graduate university students of mechanical engineering and manufacturing.

The book consists of eleven chapters divided into three parts entitled "Basics", "Fundamentals", and "Applications", respectively.

The first part, containing Chapters 1 through 3, provides an analytical description of part surfaces, basics of differential geometry of sculptured part surfaces, along with principal elements of the theory of multiparametric motion of a rigid body in the Euclidean three-space. In Chapter 1 the author presents the essential mathematical concepts that form the basis for the theory of part surface generation. Although the principal elements of the classical differential geometry of surfaces are widely used in the text, the focus is on the difference between classical differential geometry and engineering geometry of surfaces. Numerous examples of the calculation of major part surface elements are provided. Chapter 2 is devoted to the generalized analysis of kinematics of sculptured part surface generation. The definitions and determinations of major applied coordinate systems are introduced

in Chapter 3. The matrix approach for the coordinate system transformations is considered. Useful notations and practical equations are provided in an attempt to make the book a self-sufficient unit suitable for a self-study.

The core of the book is the second part which introduces the fundamentals of the theory of part surface generation. It includes an analytical description of the geometry of contact of two smooth regular surfaces, a novel analytic method of investigation of the cutting tool geometry, and a set of analytically described conditions of proper part surface generation. Five chapters are included in this part of the monograph. In Chapter 4 the author considers the local characteristics of contact of two smooth regular surfaces that make tangency of first order. A new method of profiling the form-cutting tools for sculptured part surface machining on a multiaxis NC machine is included in Chapter 5. Based on elements of the theory of enveloping surfaces, methods of profiling form-cutting tools for machining part surfaces on conventional machine tools are also considered. Chapter 6 presents in detail some methods of transformation of the generating body of the form-cutting tool into a workable cutting tool. Numerous practical examples of the calculations are also given in this chapter. The necessary and sufficient conditions for proper part surface generation are proposed and examined in Chapter 7. These conditions are represented in an analytical form. The chapter ends with methods for the global verification of the conditions of proper part surface generation. Chapter 8 provides some analytical methods for the calculation of the deviations of the actual machined part surface from the desired part surface. Two principal kinds of deviations are distinguished and methods for the calculation of the elementary surface deviations are proposed. The conditions under which the principle of superposition of elementary surface deviations is applicable are given.

The final part of the book, consisting of three chapters, is devoted to application of the proposed (DG/K-based methods of part surface generation. The selection of the criterion of optimization is discussed in Chapter 9. Various criteria of efficiency of machining operation are considered and the tight connection of the economical criteria of optimization with geometrical analogues is illustrated. Chapter 10 deals with local, regional, and global synthesis of the most favorable operations of part surface machining. The possibility of development of the DG/K-based CAD/CAM system for the optimal sculptured part surface machining is revealed. In the last Chapter 11 of the book the readers are provided with numerous practical examples of implementation of the proposed theory of part surface generation.

The main advantages of the book are the careful introduction of concepts and the good choice of many examples illustrating the most complex features of the proposed theory of part surface generation. The author introduces all the material in such a way that it can readily be put into practice. The topics covered in the book

enable the reader to synthesize optimal part surface machining operation and optimal means for these purposes. I recommend the book *Generation of Surfaces*: *Kinematic Geometry of Surface Machining* by Stephen P. Radzevich to anyone concerned with CAD/CAM-oriented programs or starting work on software packages for sculptured part surface machining.

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