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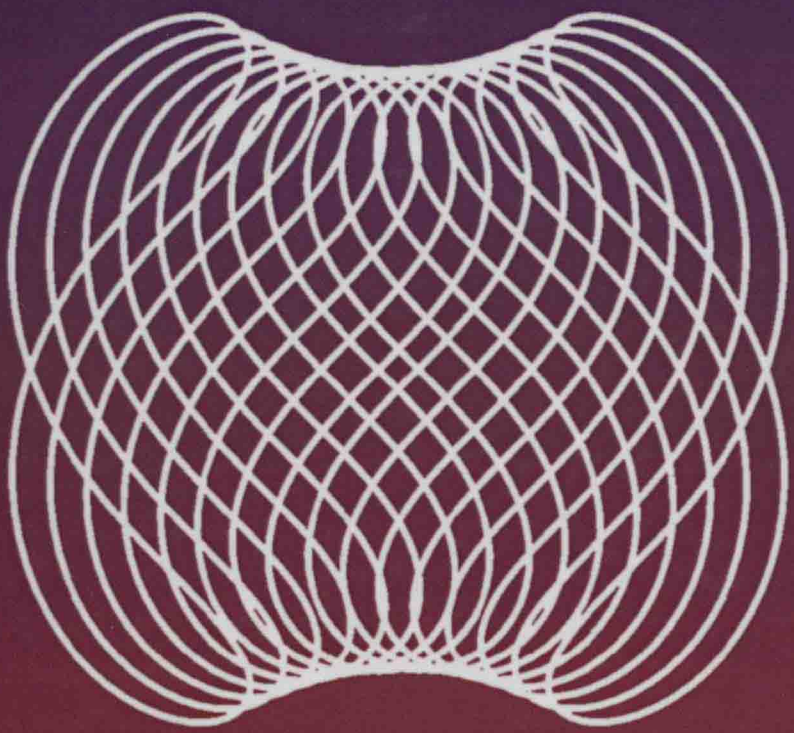

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Computer-Aided Graphing and Simulation Tools for AutoCAD Users

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After some thinking, I decided to dedicate this book to the people of Google: Your work makes my work more productive every day and will probably help to sell a few extra copies of this book as well.

Preface

OVER THE COURSE OF ALMOST TWO DECADES, I developed a number of Pascal and **AutoLISP** for **AutoCAD** programs and **Working Model 2D** simulations that I used in my publications and presentations. Occasionally, people aware of these computer applications asked for evaluation copies, which I gladly provided them. Such requests encouraged me to spend more time improving and documenting these applications, and ultimately determined me to make these applications and the algorithms behind them available to a wider audience. This is how the idea of writing this book was born.

The intended readership for this book are students, scholars, scientists, and engineers who have access to **AutoCAD** and **Working Model 2D** software and are interested in information visualization, motion simulation of mechanical systems, numerical analysis, optimization, and evolutionary computation. Those who use **AutoCAD LT**, or have access to only a **DXF** viewer, can still make substantial use of this book and of the accompanying programs and simulations.

The first two chapters describe plotting programs `D_2D` and `D_3D`, which have features not yet available in popular software like **MATLAB®**, **Excel**, or **MathCAD**. Some of these features are: showing extrema and zeros of 2D graphs, automatic numbering of data points, controlling the plot appearance from within input data file, plotting inequalities of two variables, trimming the portions of function surface that exceed the plot box, projecting the gradient on the bottom plane in 3D plots, logarithmically spacing level curves, and **DXF** export.

Chapter 3 introduces a collection of Pascal programs and procedures for generating dynamic 2D graphs with scan lines and scan points, for manipulating ASCII files and for viewing **R12 DXF** and **PLT AutoCAD** export files. It also describes two **AutoLISP** applications for plotting curves and surfaces and for generating 3D models consisting of various geometric primitives and predefined blocks using vertex coordinates and model description read from file.

Chapter 4 discusses several algorithms for finding the zeros and minima of functions of one or more variables and for multicriteria optimization. Also presented is a new evolutionary algorithm that explores the boundary between feasible and unfeasible spaces in optimization problems—it is known that in many practical problems the minimum is bounded. Numerical applications of each of these algorithms are accompanied by plots and animations generated using the `D_2D` and `D_3D` programs.

Chapters 5 and 6 introduce a series of procedures, accompanied by examples and the underlying theory, for the kinematic simulation of a wide variety of planar linkage mechanisms.

Chapter 7 deals with the synthesis of the profile of rotating disc cams operating in conjunction with various type followers (pointed, with roller, flat, translating or oscillating). Iterative methods for analyzing the respective cam-follower mechanisms are also presented. In addition, a procedure for synthesizing the follower motion using **AutoCAD** splines is described.

Chapter 8 reviews the theory of planar involute gears and presents a number of **Working Model 2D** simulations and an **AutoLISP** application to illustrate this theory. The **AutoLISP** program is particularly useful because it allows the generation, directly inside **AutoCAD**, of involute gear profiles, internal or external, with any number of teeth.

Chapter 9 is a collection of problems and applications from areas like dynamical systems, vibrations, kinematics, robotics, multidimensional visualization, etc., solved using the software tools presented in the earlier chapters, or using **Working Model 2D**.

Source codes and executables of the programs and simulations discussed in the book are available upon request from the author. The referred animation files can be downloaded from the publisher's website at www.crcpress.com/product/isbn/9781482252903/ or from http://faculty.tamucc.edu/psimionescu/cagstau.html.

While every effort has been made to provide error-free analytical derivations and software implementations of these derivations, in no event shall the author or publisher be liable for any claim, damages, or other liability in connection with the use of the material in this book and of the accompanying computer programs and simulations.

As with any text, the clarity of the writing can be improved and the collection of examples expanded. The **AutoLISP** and Pascal programs provided with this book can also sustain improvements or can be translated into other programming languages. I would therefore appreciate any comments, suggestions, or reports of errors. In particular, I would welcome any serious offer for collaboration on future editions. So my respected reader, before posting critical reviews about this book, please read once again this last paragraph.

Thank you,

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Acknowledgments

THE **PCX** RASTER OUTPUT METHOD implemented in some of the programs provided with this book follows an online posting of Bren Sessions of Corvallis, Oregon. Horia Brădău of Vaughan, Ontario, contributed an earlier **AutoLISP** program for the generation of involute gears. Thanks are extended to Dr. Constantin Stăncescu of University Polytechnica of Bucharest, who adapted the **AutoLISP** programs provided with this book to run in any version of **AutoCAD** up to its 2014 release. My appreciation goes to all those that encouraged me to complete this project and to CRC Press for their careful involvement in the preparation of this book for publication.

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