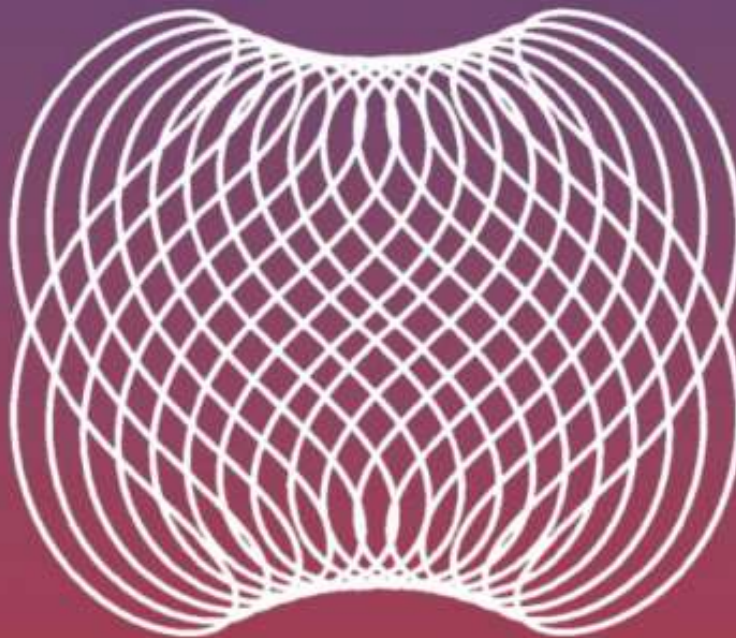


Chapman & Hall/CRC  
Computer & Information Science Series

# Computer-Aided Graphing and Simulation Tools for AutoCAD Users



**P. A. Simionescu**



CRC Press  
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A CHAPMAN & HALL BOOK

## Chapman & Hall/CRC Computer & Information Science Series

This book allows readers to expand the versatility of AutoCAD® design and documentation software. It provides ready-to-use procedures and computer programs for solving problems in a variety of application areas, including computer-aided design, data visualization, evolutionary computation, numerical methods, single and multicriteria optimization, linkage and robot kinematics, cam mechanisms, and involute gears.

Students, engineers, and scientists alike will benefit from the text's illustrative examples, first-rate figures, and many original problem-solving approaches, as well as the included software tools for producing high-quality graphs and simulations. Those who use AutoCAD LT, or have access to only a DXF viewer, can also make substantial use of this book and the accompanying programs and simulations.

### Features

- Provides access to unique software tools for data visualization, CAD format conversion, and computer-generated animations and simulations
- Describes new multidimensional visualization techniques and evolutionary algorithms
- Discusses new approaches to cam mechanism design and analysis
- Introduces a series of procedures for the kinematic simulation of a wide variety of planar linkage mechanisms
- Contains illustrative examples, first-rate figures, and many original problem-solving approaches

### Read the Reviews:

"This is a unique book in that it covers a variety of engineering problems, ranging from graph plotting and optimization to mechanical component analysis. The figures are great and the procedures are described with clearly explained computer codes."

—Professor Kalyanmoy Deb, Michigan State University

"Simionescu's book collects the long experience of the author in teaching kinematics of mechanisms and machines by using software environments commonly available to students and professionals. It shows how graphic tools can be employed in solving real problems in mechanical engineering."

—Professor Raffaele Di Gregorio, University of Ferrara, Italy



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## 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 with. Such requests encouraged me to spend more time improving and documenting them, and ultimately determined me to make these application and the algorithms behind them available to a wider audience. It is how the idea of writing this book was born.

The intended readership for this book is students, scholars, scientists and engineers interested in information visualization, motion simulation of mechanical systems, numerical analysis, optimization and evolutionary computation that have access to **AutoCAD** and **Working Model 2D** software. Those who use **AutoCAD LT** software, 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 in detail plotting programs **D\_2D** and **D\_3D** which have features not yet available in popular software like **MATLAB**, **Excel** or **MathCAD**. Such 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, **DXF** export etc.

Chapter 3 introduces a collection of Pascal programs and subroutines 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 function 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 examples done with 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 subroutines, accompanied by examples and by 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, multidimension 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 and the referred animation files are available upon request from the author.

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 and reports of errors. In particular I would welcome any serious offer of collaboration on future editions. So my respected reader, before posting critical reviews about this book, please read once again this last paragraph.

Thank you,

P.A. Simionescu

April, 2014

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