



# Polynomial Root-finding and Polynomiography

*Bahman Kalantari*

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## **Polynomial Root-finding and Polynomiography** Bahman Kalantari

This book offers fascinating and modern perspectives into the theory and practice of the historical subject of polynomial root-finding, rejuvenating the field via polynomiography, a creative and novel computer visualization that renders spectacular images of a polynomial equation. Polynomiography will not only pave the way for new applications of polynomials in science and mathematics, but also in art and education. The book presents a thorough development of the basic family, arguably the most fundamental family of iteration functions, deriving many surprising and novel theoretical and practical applications such as: algorithms for approximation of roots of polynomials and analytic functions, polynomiography, bounds on zeros of polynomials, formulas for the approximation of Pi, and characterizations or visualizations associated with a homogeneous linear recurrence relation. These discoveries and a set of beautiful images that provide new visions, even of the well-known polynomials and recurrences, are the makeup of a very desirable book. This book is a must for mathematicians, scientists, advanced undergraduates and graduates, but is also for anyone with an appreciation for the connections between a fantastically creative art form and its ancient mathematical foundations.

**Contents:** Approximation of Square-Roots and Their Visualizations; The Fundamental Theorem of Algebra and a Special Case of Taylor's Theorem; Introduction to the Basic Family and Polynomiography; Equivalent Formulations of the Basic Family; Basic Family as Dynamical System; Fixed Points of the Basic Family; Algebraic Derivation of the Basic Family and Characterizations; The Truncated Basic Family and the Case of Halley Family; Characterizations of Solutions of Homogeneous Linear Recurrence Relations; Generalization of Taylor's Theorem and Newton's Method; The Multipoint Basic Family and Its Order of Convergence; A Computational Study of the Multipoint Basic Family; A General Determinantal Lower Bound; Formulas for Approximation of Pi Based on Root-Finding Algorithms; Bounds on Roots of Polynomials and Analytic Functions; A Geometric Optimization and Its Algebraic Offsprings; Polynomiography: Algorithms for Visualization of Polynomial Equations; Visualization of Homogeneous Linear Recurrence Relations; Applications of Polynomiography in Art, Education, Science and Mathematics; Approximation of Square-Roots Revisited; Further Applications and Extensions of the Basic Family and Polynomiography.

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