Numerical algebraic geometry is a newly evolving area of mathematics which makes use of homotopy continuation methods to handle complex solutions of polynomial equations. The discipline originates from a 1996 paper by A. Sommese and C. Wampler, who also wrote the introductory textbook [SW]. Whereas [SW] treats the theory behind the algorithms, the focus of the book under review is on explicit computional examples and case studies, carried through in the software system BERTINI created by the authors.

Let me quote from the preface:

> *The goal of this book is threefold:*
>
> 1. *Explain enough background on solution sets of polynomial systems so that the reader has a basic understanding of the geometry of such sets and can understand both the data types and the breadth of the various computations of numerical algebraic geometry.*
> 2. *Show the reader how to use Bertini to solve systems efficiently and interpret the putput correctly.*
> 3. *Provide a detailed manual of commands and settings for Bertini.*

The book consists of four parts.

The first part deals with isolated solutions, introducing at the same time some of the mathematical background, the basics of homotopy continuation, and, by giving first examples, the software BERTINI. To demonstrate how the authors catch the attention of the reader, let us take a look at Chapter 2, where continuation methods make their first appearance: The authors start from an intuitive point of view, give a first, well illustrated example, analyse this example in more detail, introduce homotopies formally, explain how to deal with homotopies via numerical path tracking methods, and open up a first page in the BERTINI guide by showing how the software can handle some of the concepts discussed. Further topics in Part I include *Adaptive Precision and Endgames* and *Types of Homotopies*.

In the second part of the book, the authors discuss systems of polynomial equations whose solution sets do not consist of isolated solutions only. They introduce the algebraic geometry concept of irreducible components of solution sets and show how to represent these components as a *numerical irreducible decomposition* using so-called *witness sets*. Highlighted by BERTINI examples, some of which originate from robot kinematics, the authors explain how to compute witness sets and numerical irreducible decompositions, addressing in particular the expected accuracy of the coefficients of the polynomials.

Part III of the book presents further algorithms and applications. The topics range from operations on components of solution sets via seeking real solutions to solving big polynomial systems arising from differential equations. A number of applications to algebraic geometry are included as well.

In Part IV, the authors provide the promised manual of commands and settings for BERTINI. The text closes with a few remarks on parallel computing and on related software.

The book is very well written, nicely illustrated, and provides guiding examples of BERTINI code. It is a highly welcome supplement to [SW]. Complementary to the book, the authors provide a webpage, where, in particular, the BERTINI input files presented in the book are available.

References

[SW] A.J. Sommese and C.W. Wampler. *The Numerical Solution of Systems of Polynomials Arising in Engineering and Science*. ISBN 981- 256- 184-6. Word Scientific Publishing Co. Plte. Ltd. 2005 .