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**PREFACE:**  
**RECENT ADVANCES IN POLYNOMIAL OPTIMIZATION**  
**THEORY AND METHODS**

This special issue of Numerical Algebra, Control and Optimization is dedicated to the themes of the workshop on “Future Trends in Polynomial Optimization” (POP23), which was held in November 2023 at LAAS-CNRS in Toulouse, France. The workshop brought together researchers to discuss recent advances and future directions in polynomial optimization.

Polynomial optimization, at the confluence of algebraic geometry and convex optimization, has seen remarkable progress in recent years. The development of Moment-Sum-of-Squares (SOS) hierarchies, in particular, has provided a powerful framework for solving a wide range of problems in optimization and control. The contributions in this volume reflect the breadth and depth of current research in this vibrant field.

The papers in this special issue cover a wide range of topics, including:

**Theoretical Foundations:** Several papers explore the theoretical underpinnings of polynomial optimization. Topics include the Christoffel function, the hardness of deciding the finite convergence, convergence rates and cases of non-convergence of moment-SOS hierarchies for global polynomial optimization.

**Algorithmic Developments:** This collection also highlights new algorithmic approaches. A new framework for polynomial quasi-variational inequalities with Moment-SOS relaxations is presented, and the link between 1-norm approximation and effective Positivstellensätze for the hypercube is explored.

**Applications:** The practical relevance of polynomial optimization is demonstrated through applications in various domains. These include the problem of determining the exit location of stochastic processes, covering problems in discrete geometry, and moment and tensor recovery problems.

We would like to thank the authors for their insightful contributions and the reviewers for their invaluable feedback.

We hope that this collection of papers will inspire further research and collaboration in the exciting field of polynomial optimization.

Guest Editors:

Didier Henrion

LAAS-CNRS, Toulouse, France

France and Czech Technical University in Prague, Czechia

henrion@laas.fr

Monique Laurent

CWI Amsterdam and Tilburg University

The Netherlands

monique@cw.nl

Victor Magron  
LAAS-CNRS, Toulouse, France  
victor.magron@laas.fr

Jiawang Nie  
University of California, San Diego, USA  
njw@math.ucsd.edu

Edouard Pauwels  
Toulouse School of Economics, France  
edouard.pauwels@tse-fr.eu