A short course on

The Moment-SOS Hierarchy and the Christoffel function

by **Professor Jean Bernard Lasserre**

7, 8, 11, 12 September 2023

10am – 12pm

I4-01-03 (Innovation 4.0, level 1 Seminar Room)

❖ **Session 1**: Moments and positive polynomials

❖ **Session 2**: LP- and SOS-based positivity certificates for optimization

❖ **Session 3**: Some applications of the Moment-SOS hierarchy

❖ **Session 4**: The Christoffel function and its links with the Moment-SOS hierarchy

Course title: The Moment-SOS Hierarchy and the Christoffel function

Speaker: Professor Jean Bernard Lasserre

Number of sessions: 4 sessions (2 hours per session)

Schedule

Dates	7 September, 8 September, 11 September, 12 September 2023
Time	10am – 12pm
Venue	I4-01-03 (Innovation 4.0, level 1 Seminar Room)

Course Information

Session 1: Moments and positive polynomials
In this course, we briefly describe the theory of moments and positive polynomials which provides the rationale behind the Moment-sum-of-squares hierarchy.

Session 2: LP- and SOS-based positivity certificates for optimization
We explore linear programming and sum-of-squares approaches to producing positivity certificates for optimization.

Session 3: Some applications of the Moment-SOS hierarchy
We explore the intersection of the theory of moments and positive polynomials with several areas (optimization, real algebraic geometry, functional analysis). We also explore the almost endless list of important applications (optimization, computational algebra and geometry, probability & statistics, signal processing, control, optimal control and nonlinear PDEs, quantum information, to cite a few).

Session 4: The Christoffel function and its links with the Moment-SOS hierarchy
While being an old tool from the theory of approximation and orthogonal polynomials, we claim that the Christoffel function provides a simple and easy-to-use tool for some problems in data analysis, approximation and interpolation of discontinuous functions. Moreover, we will reveal its links (some quite surprising) with optimization, sum-of-squares, certificates of positivity, equilibrium measures of compact sets, and more.

Biography:

Professor Lasserre obtained his PhD (1978) and "Doctorat d'Etat" (1984) degrees both from Paul Sabatier University in Toulouse, France. He has been at LAAS-CNRS in Toulouse since 1980, where he is currently an Emeritus Director of Research. He is also a member of the Institute of Mathematics of the University of Toulouse. His research interests include optimization, probability theory, real algebraic geometry, operational research. He is a pioneer in the field of global polynomial optimization based on polynomial sums of squares and the Lasserre hierarchy.

Prof. Lasserre was awarded the John-von-Neumann Theory Prize in 2015. He also received the Khachiyan Prize awarded by the INFORMS Optimization Society in 2015, and the Lagrange Prize from SIAM and the Mathematical Optimization Society in 2009. He is a member of SIAM (2014) and received an ERC Advanced grant in 2014. He is an invited speaker at the International Congress of Mathematicians in 2018. He is also the recipient of the INRIA-Academy of Sciences Grand Prize in 2021