EE464: Lecture 1

- ee464: semidefinite optimization and algebraic techniques
- Sanjay Lall

Requirements and prerequisites

- class attendance
- a few homeworks
- no exams
- prereqisities:
  - linear algebra (ee263 at least)
  - convex optimization (ee364a)
  - mathematical maturity

Course overview

- research-oriented class
- convex optimization
- algebraic geometry
  - polynomial equations and inequalities
- focused on the tools, not a specific set of applications
- ideas from the last 10 years

Topics covered

- *optimization:*

  semidefinite programming; quadratic programming and SDP relaxations; applications

- *polynomial programming:*

  constructing dual problems via semidefinite programming; valid inequalities, and positive cones of real polynomials; introduction to algebraic geometry; formal theory of the reals

- *algebra and geometry:*

  the correspondence between ideals and varieties; Nullstellensatz and its interpretation via duality and certificates; computation via linear algebra and Groebner bases

- *sum-of-squares decomposition:*

  efficient computation via semidefinite programming; duality of the SOS decomposition via Schur complements, moments, and liftings

- *semialgebraic sets:*

  cones, monoids and ideals; quantifier elimination; computation of positivstellensatz certificates using semidefinite programming; exploiting structure, sparseness, symmetry, quotient rings

References

- a new course
- we may post references instead of notes
- current research with many sources
- some material from
  - forthcoming book: Semidefinite Optimization and Convex Algebraic Geometry by Blekherman, Parrilo and Thomas
  - workshop notes by Lall and Parrilo