CLAREMONT CENTER
for MATHEMATICAL SCIENCES
C C M S C O L L O Q U I U M

Linear matrix inequalities and their limitations

by

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Abstract: One of the main developments in optimization over the last 15 years is Semi-Definite Programming. It treats problems which can be expressed as a linear matrix inequality (LMI) and it has been found over the last decade that many problems from many branches of science, eg linear systems theory, combinatorial optimization, statistics, etc can be be treated with LMIs. Any such problem is necessarily convex, so the determining the scope and range of applicability comes down to the question: How much more restricted are LMIs than Convex Matrix Inequalities? There are several main branches of this pursuit. First there are two fundamentally different classes of linear systems problems. Ones whose statements do depend on the dimension of the system "explicitly" and ones whose statements do not. *Dimension dependent systems problems* lead to traditional semialgebraic geometry problems, while *dimensionless systems problems* lead directly to a new area which might be called noncommutative semialgebraic geometry. The classic results of control lead to noncommutative problems. In this talk after laying out the distinctions above we give results and conjectures on the answer to the LMI vs convexity question.

About the speaker: Bill Helton typically works on functional analysis problems arising from a variety of areas. He was one of the originators of noncommutative geometry. Also his earlier articles concerned circuit theory, distributed systems, and aspects of the theory of operators on Hilbert space which come from circuits, systems, differential and integral equations, spectral theory. The theoretical studies of amplifier design by Youla and by Helton were the first papers in the now ubiquitious area called H-infinity engineering. The focus of Helton's recent work is treating the algebra behind matrix inequalities in a systematic way; this has necessitated development of real algebraic geometry for non-commutative polynomials. A related interest is computer algebra and Helton's group is the main provider to Mathematica of general non-commutative computer algebra capability. Bill Helton received the bachelor's degree in mathematics from the University of Texas, Austin, the Master's and Ph.D degree in mathematics from Stanford University. He was at SUNY, Stony Brook, as an Assistant and Associate Professor. He visited UCLA for six months and subsequently moved to UC San Diego where he is currently Professor of Mathematics. He was a Guggenheim Fellow and is an IEEE Fellow and has delivered plenary addresses at conferences ranging from the annual meeting of the AMS, the European Electronic Circuits Society, the Mathematical Theory of Networks and Systems, SIAM Control and Linear Algebra Society meetings.

Wednesday, May 2, 2012, at 4:15pm

Freeburg Forum (Kravis Center, LC 62), Claremont McKenna College

Refreshments at 4:00 p.m. in Freeburg Forum Courtyard & wine and cheese after the talk in CMC Math Commons Room (Adams 208)

The dinner will be hosted by Prof. Stephan Garcia.
Please contact Prof. Garcia if you are interested in attending the dinner.