Intrafaculty Colloquium: Mathematics and Physics

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Non-Commutative Polynomial Optimization

In this talk, I consider optimization problems with polynomial inequality constraints in non-commuting variables. These non-commuting variables are viewed as bounded operators on a Hilbert space whose dimension is not fixed; and the associated polynomial inequalities, as semidefinite positivity constraints. To solve these problems, I introduce a complete hierarchy of semidefinite programming relaxations. This hierarchy, that can be understood as the non-commutative analogue of the Lasserre-Parrilo method for polynomial minimization, gives the user the power to make rigorous claims about the possible expectation values of infinite dimensional operators satisfying a number of polynomial identities. I will review several applications that non-commutative polynomial optimization has found in physics and quantum information theory since the conception of our hierarchy, as well as some interesting extensions of the original method. Finally, I will list some of the current challenges of this young field.

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