Semi definite Programming is met with increasing interest within the power systems community. Its most notable application to-date is a convex formulation of the AC optimal power flow problem. At the same time, semi definite programs can be applied on LMI conditions to derive Lyapunov functions that guarantee power system stability.

In this talk we will report on recent work both on power system stability and optimization. First, we will present a novel robust stability toolbox for power grids with its extensions to inertia mimicking and topology control. In that, the quadratic Lyapunov functions approach is introduced for transient stability assessment.

Second, we will propose formulations for the integration of chance constraints for different types of uncertainty in the AC optimal power flow problem. We demonstrate our method with numerical examples, and we investigate the conditions to achieve zero relaxation gap.