MAFIA - the seminar you can't refuse

Controlling quantum systems through their boundaries: the case of graph-like systems

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Abstract: The development of Quantum Information Theory and the aim for building quantum computers has increased the relevance of controlling quantum systems. The main goal of this talk is to present a non-standard method for controlling the state of a quantum system by modifying its boundary conditions instead of relying on the action of external fields to drive the state of the system.

In order to show the viability of this control scheme, we introduce what we call Quantum Circuits (a generalisation of Quantum Graphs), on which we define a concrete family of boundary control systems basing on the self-adjoint extensions of the Laplace(-Beltrami) operator.

We will briefly review the problem of existence of solutions for the Schrödinger equation with time-dependent boundary conditions basing on the approaches by J. Kisynski and B. Simon, providing a new stability result for Hamiltonians with constant form domain. This stability result has far reaching consequences for Quantum Control Theory as it allows to obtain a priori estimates on the error committed when driving the state of the system.

Finally, basing on the stability result and a controllability result by T. Chambrion et al. (2009) on the controllability for a class of bilinear quantum control systems, we are able to show the approximate controllability for our family of boundary control systems.