MP 13: Offene Quantensysteme

Zeit: Donnerstag 9:40–10:30 Raum: ZHG 003

MP 13.1 Do 9:40 ZHG 003

Differential Geometry of Coherently Controlled Markovian Open Quantum Systems — •Corey O'Meara[1], Gunther Dirr[2], and Thomas Schulte-Herbrüggen[1] — [1]TU-Munich, Dept. Chem. — [2]University of Würzburg, Inst. Math.

We extend standard Markovian unital and non-unital quantum channels by allowing for coherent Hamiltonian controls. We show that the geometry of these controlled channels can be described in terms of *Lie (sub)semigroups* in a way [1] that is more helpful for control engineering than the usual picture of Lindblad and Kossakowski. For standard dissipative interactions with the environment (phase damping, depolarizing, amplitude damping etc) and different coherent controls, we specify the tangent cones (Lie wedges) to the Lie semigroups [2].

These cones are the counterpart of the infinitesimal generator of a single one-parameter semigroup. They comprise all directions the open quantum system can be steered along. Being readily scalable to multi-qubit systems, such a differential characterisation is highly valuable for approximating reachable sets of given initial quantum states in a plethora of experimental implementations. The advantage over estimates by majorisation even increases with system size.

References:

[1] G. Dirr, U. Helmke, I. Kurniawan, and T. Schulte-Herbrüggen, Rep. Math. Phys. 64 (2009) 93–121 [doi:10.1016/S0034-4877(09)90022-2]

[2] C. O'Meara, G. Dirr, and T. Schulte-Herbrüggen, IEEE Trans. Control, in press (2011), [see: http://arxiv.org/abs/1103.2703v2]

MP 13.2 Do 10:05 ZHG 003

Mappings of open quantum systems onto chain representations and Markovian embeddings — •M.P. Woods[1,2], R. Groux[3], A.W. Chin[1], S.F. Huelga[1], and M.B. Plenio[1,2] — [1]Institut für Theoretische Physik, Universität Ulm, D-89069 Ulm, Germany — [2]QOLS, Blackett Laboratory, Imperial College London, SW7 2BW, United Kingdom — [3]Lycee Polyvalent Rouviere, Rue Sainte Claire Deville. BP 1205, 83070 Toulon, France

This talk is concerned with the mapping of the Hamiltonian of open quantum systems onto chain representations, which forms the basis for a rigorous theory of the interaction of a system with its environment. This mapping progresses as an iteration which gives rise to a sequence of residual spectral densities whose properties determines the essential physical properties of the system. The rigorous mathematical properties of this mapping have been unknown so far. Here we develop the theory of secondary measures to derive an analytic, non-iterative expression for the sequence solely in terms of the initial measure and its associated orthogonal polynomials of the first and second kind. By formulating this new result in terms of a theory concerning Jacobi matrices, we find a very general connection between spectral theory and open quantum systems. These results make a significant and mathematically rigorous contribution to the understanding of the theory of open quantum systems, and paves the way towards the efficient simulation of these systems, which within the standard methods, is often an intractable problem.

A preprint is available here: http://arxiv.org/abs/1111.5262