

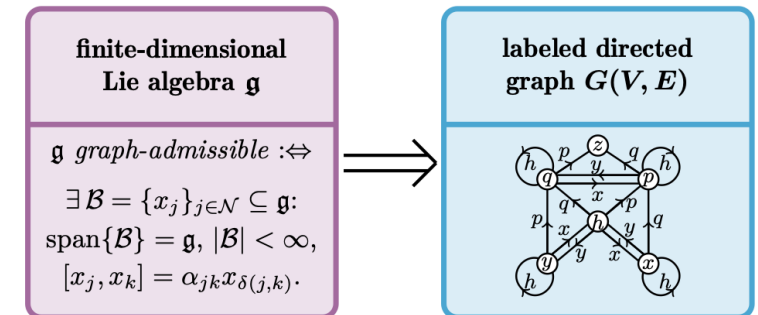
Dr. David Edward Bruschi (FZ Jülich)

Toward Algebraic Quantum Control

Date: Monday, October 19, 2026

Time: 12:00 – 13:00

Location: Building E2 6, Room E.04



From: T. Heib & D.E. Bruschi, arXiv:2601.16161 (2026).

Determining exact dynamics is paramount in quantum simulation, computing, and control. Classically this means solving coupled nonlinear differential equations; in quantum mechanics, non-commuting operators make it far harder. The Wei-Norman algorithm systematically factorizes the time-evolution operator into a finite product of exponentials and is increasingly central to quantum computing and control. It is well developed for finite-dimensional systems, but its extension to continuous-variable systems remains open. A recent approach identifies continuous-variable Hamiltonians where it applies by analyzing the dimension of dynamical Lie algebras via their generating terms. We generalize these results to a broader class of physically relevant bosonic Hamiltonians, reduce the complexity of verifying finiteness conditions from quadratic to linear, and introduce a visual algorithm to implement it. We also identify a universal Lie algebraic structure encompassing all finite-dimensional algebras in this framework. This is a major step toward classifying Hamiltonian Lie algebras, with potential impact on quantum control, computing, and efficient algorithms for new quantum technologies.

