

ABSENSE OF LOCAL MAXIMA FOR OPTIMAL CONTROL OF TWO-LEVEL QUANTUM SYSTEMS

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The goal of optimal control for a quantum system whose evolution is governed by Schrodinger equation is to find controls which maximize target objective functional, such as quantum average of some observable. Often numerical methods are used to find optimal controls. This makes important the problem of analysis of the existence or absence of local maxima (traps) of the target functional, since their presence may hinder the numerical search from finding true global maxima. Significant progress in the analysis of trap was made in recent works by H. Rabitz, A.N. Pechen, D.J. Tannor, R. Wu, C. Brif, P. de Fouquieres, S.G. Schirmer and others [1–3]. However, systems without traps were not known. In the joint work with A.N. Pechen [4] we present the proof of the absence of local maxima for a wide range of target functionals for two-level quantum systems governed by Schrodinger equation.

Theorem. *For two-level quantum system with controlled evolution*

$$i\frac{d}{dt}U_t^f = [H_0 + f(t)V]U_t^f, \quad [H_0, V] \neq 0$$

all maxima of functionals $J_{i \rightarrow f}(f) = |\langle \psi_f | U_T^f | \psi_i \rangle|^2$, $J_O(f) = \text{Tr}(U_T^f \rho_0 U_T^{f\dagger} O)$, $J_W(f) = |\text{Tr}(U_T^f W^\dagger)|^2$ are global that is, there are no local maxima.

References

1. A. Pechen, C. Brif, R. Wu, R. Chakrabarti, H. Rabitz. General unifying features of controlled quantum phenomena. // Phys. Rev. A, 82 (2010), 030101(R).
2. A. Pechen, D.J. Tannor. Are there traps in quantum control landscapes? // Phys. Rev. Lett., 106 (2011), 120402.
3. P. de Fouquieres, S.G. Schirmer. A closer look at quantum control landscapes and their implication for control optimization. // Infinite Dimensional Analysis, Quantum Probability and Related Topics. 16:3 (2013), 1350021.
4. A. Pechen, N. Il'in. Trap-free manipulation in the Landau-Zener system. // Phys. Rev. A, 86 (2012), 052117.