Geometric and numerical methods in optimal control for the time minimal saturation of a pair of spins

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Optimal control algorithms were introduced in Nuclear Magnetic Resonance (NMR) to improve the control field very recently and at the end of the nineties, new methods appeared in optimal control of NMR systems both from the analytical and numerical points of view.

More recently, combination of geometrical optimal control base on the Maximum Principle and related numerical algorithms: gradient methods, shooting and continuation methods. We propose a complete analysis based on geometric control to classify the optimal syntheses in the single spin case. This is a crucial step to analyze the case of two spins and to construct robust control to deal with inhomogeneities due to perturbation of the applied magnetic field.

This is supplemented by numerical results combining direct methods, indirect methods and moment/lmi techniques to estimate the global optimum in both cases.