

# Extensions of Zubov's Method

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## Abstract

Zubov's theorem asserts that for an asymptotically stable fixed point of an ordinary differential equation a maximal Lyapunov function (i.e. one that works on the whole domain of attraction) can be found via the solution of a suitable first order PDE. In this talk it will be discussed how this result can be extended to perturbed and controlled systems. In the perturbed case we obtain a PDE the solution of which is a maximal robust Lyapunov function. Conversely, in the controlled case a control Lyapunov function defined on the domain of asymptotic nullcontrollability can be numerically constructed via this method. The approach is based on a reformulation of the problems as optimal control problems and on the consideration of the associated value functions. These are solutions in the viscosity sense of equations which can be obtained from Zubov's original equation by straightforward generalization.