Polynomial approximation of Hamilton-Jacobi equations: towards high-dimensional optimal feedback control

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In this talk we discuss the numerical approximation of high-dimensional Hamilton-Jacobi-Bellman (HJB) equations arising in optimal feedback control problems for semilinear parabolic equations. We consider a pseudospectral collocation approximation of the PDE dynamics, and an iterative method for the nonlinear HJB equation associated to the feedback synthesis. The latter is known as the Successive Galerkin Approximation, which can also be interpreted as a Newton iteration for the HJB equation. The resulting HJB equation needs to be solved in the state space of the discretized PDE dynamics, and therefore it is naturally of very high dimension. Conventional grid-based schemes are not suitable for dimensions higher than 5. To circumvent this difficulty, the associated linear Generalized HJB equation is approximated via a separable polynomial approximation ansatz. Stabilizing feedback controls are obtained from solutions to the HJB equations for systems of dimension up to fourteen.

Joint work with: Karl Kunisch (RICAM, Linz and Graz, AT).

References

[1] D. Kalise and K. Kunisch. [pdf], to appear in SIAM Journal of Scientific Computing. D. Kalise and K. Kunisch Polynomial approximation of high-dimensional Hamilton-Jacobi-Bellman equations and applications to feedback control of semilinear parabolic PDEs. arXiv:1702.04400, to appear in *SIAM J. Sci. Comput.*, 2018.