An Approach to Estimating Solutions of Hamilton-Jacobi Equations based on Data-driven Methods using Second-Order Information

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From approximation theory, the problem of reconstructing a function from a dataset of images of points in an efficient way has been studied as in [AS19]. On the other hand, in the context of differential equations, it is sought to find solutions that cannot be explicitly determined using numerical analysis tools. In this talk, we will present an approach to estimating solutions of Hamilton-Jacobi equations related to optimal control problems based on the work of Azmi, Kalise and Kunisch ([AKK21]), where they reconstruct the function using polynomials in a way that avoids very high computational costs as the dimension grows. We will also compare, in a practical case, how the use of second-order information, which can be obtained from the structure of the optimal control problem (see [CF14] [CFS15]), helps to achieve a good approximation with a smaller dataset.

[AKK21] Behzad Azmi, Dante Kalise, and Karl Kunisch. Optimal feedback law recovery by gradient-augmented sparse polynomial regression. *Journal of Machine Learning Research*, 22(48):1–32, 2021.

[AS19] Ben Adcock and Yi Sui. Compressive hermite interpolation: Sparse, high-dimensional approximation from gradient-augmented measurements. *Constructive Approximation*, 50(1):167–207, Aug 2019.

[CF14] P. Cannarsa and H. Frankowska. From pointwise to local regularity for solutions of hamilton–jacobi equations. *Calculus of Variations and Partial Differential Equations*, 49(3):1061–1074, Mar 2014.

[CFS15] P. Cannarsa, H. Frankowska, and T. Scarinci. Second-order sensitivity relations and regularity of the value function for mayer's problem in optimal control. *SIAM Journal on Control and Optimization*, 53(6):3642–3672, 2015.