Spectral Deferred Correction: from theoretical analysis to design of new time-parallel algorithms

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Since its introduction by Dutt, Greengard and Rokhlin in 2000, Spectral Deferred Corrections (SDC) have attracted a lot of attention from the PinT community, especially since it is a core component of the PFASST algorithm. The method itself, being iterative, uses a different paradigm than that of the classical time-integration methods: instead of computing the next solution step-by-step in a purely sequential way, SDC uses an iterative algorithm to start from an approximated (cheap) solution, and corrects it through an iterative process. As some modifications of the algorithm can easily introduce parallelism across or within time steps, SDC can be described as a generic framework for many types of time-integration method, potentially allowing to design new PinT strategies.

In this talk, we will briefly introduce SDC and its multiple variants from the last decades (RIDC, diagonal SDC, Block-Gauss-Seidel SDC, ...), and show how all of those can be described within one single analysis framework. In particular, we will show how each of those variants can be fully described as a Runge-Kutta method with its associated Butcher table, as was recently done for the Parareal algorithm. Finally, we present how this theoretical description can be used with different strategies to develop new PinT algorithms with parallel efficiency potentially better than those of the current PinT methods.