Task graph-based performance analysis of PinT methods

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One approach to improve the performance and efficiency of Parallel-in-Time (PinT) methods for future HPC systems is to develop load-balancing strategies that respond to load imbalances that may arise, for example, through fault-tolerance mechanisms or by coupling PinT methods with adaptive space-time schemes. A first step in developing such strategies is to develop a performance model to predict the runtimes for different PinT methods, which can later be used to compare different load-balancing strategies.

In this talk, we present a new task graph-based performance analysis for Parareal, PFASST, and MGRIT, three of the most popular PinT methods. For the analysis, a task graph is created based on a data-driven version of the selected algorithm and its parameter setting. In this way, any variation of the algorithms and settings can be covered. In addition to scheduling-based runtime analysis for a given number of processors, task graphs also allow us to theoretically determine the minimum possible parallel runtime based entirely on the algorithm rather than a chosen implementation. We demonstrate the generality and correctness of the performance analysis by comparing predicted runtimes of the model with simulation times of different PinT libraries.