

The thesis presents a contribution to the analysis and visualization of computational performance based on event traces with a particular focus of parallel programs and High Performance Computing (HPC).

Event traces contain detailed information about specified incidents (events) during run-time of programs and allow minute investigation of dynamic program behavior, various performance metrics, and possible causes of performance flaws. Due to long running and highly parallel programs and very fine detail resolutions, event traces can accumulate huge amounts of data which become a challenge for interactive as well as automatic analysis and visualization tools.

The thesis proposes a method of exploiting redundancy in the event traces in order to reduce the memory requirements and the computational complexity of event trace analysis. The sources of redundancy are repeated segments of the original program, either through iterative or recursive algorithms or through SPMD-style parallel programs, which produce equal or similar repeated event sequences. The data reduction technique is based on the novel Complete Call Graph (CCG) data structure which allows domain specific data compression for event traces in a combination of lossless and lossy methods. All deviations due to lossy data compression can be controlled by constant bounds. The compression of the CCG data structure is incorporated in the construction process, such that at no point substantial uncompressed parts have to be stored. Experiments with real-world example traces reveal the potential for very high data compression. The results range from factors of 3 to 15 for small scale compression with minimum deviation of the data to factors > 100 for large scale compression with moderate deviation.

Based on the CCG data structure, new algorithms for the most common evaluation and analysis methods for event traces are presented, which require no explicit decompression. By avoiding repeated evaluation of formerly redundant event sequences, the computational effort of the new algorithms can be reduced in the same extent as memory consumption. The thesis includes a comprehensive discussion of the state-of-the-art and related work, a detailed pre- sentation of the design of the CCG data structure, an elaborate description of algorithms for construction, compression, and analysis of CCGs, and an extensive experimental validation of all components.