The Sparse Grid Combination Technique in Linear Gyrokinetics

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The coming large fusion experiment ITER will heavily benefit from numerical simulations. One model for simulating the hot plasmas occurring in such a device are the gyrokinetic equations, which can resolve the micro-turbulence in the plasma. Due to their moderately high dimensionality they could profit from using sparse grids. Since the highly efficient and parallelized simulation code GENE is already at hand, the sparse grid combination technique can be used to create sparse grid solutions. In this way, the full parallelism of GENE can be used and on top of it, another layer of parallelism is introduced. This approach can on the one hand be one step toward exascale computations, since it the parallelism acts on top of the current application. On the other hand it can also be used to reduce the effect of hardware faults, which will probably occur more often on exascale architectures. We will present some results of the combination technique for the special case of linear computations in GENE. For that the optimized combination technique is used, which allows to adapt the coefficients for combination to the underlying problem, which is in our case an eigenvalue problem. It computes its combination coefficients out of an optimization problem, which is also including the search for single eigenvalues of the system. In the end, the method will have retrieved an approximation of the eigenvalue and a representation of the eigenvector in the basis of the partial solutions used for combination. This method can also be generalized to other basis functions than the partial solutions and might thus be also employed for more general problems than the gyrokinetic eigenvalue problem.