Security constrained optimization of large scale energy systems on high performance computers[1]

Author and Presenter:
Juraj Kardos (Università della Svizzera italiana)

Co-authors:
Olaf Schenk (Università della Svizzera italiana)
Drosos Kourounis (Università della Svizzera italiana)

Abstract: The electrical power grid is a critical infrastructure that should be resilient to failures. Increased penetration of the renewable energy sources is placing greater stress on the grid, shifting operation of the power grid equipment towards their operational limits [1]. Thus, any unexpected contingency could be critical to the overall operation. Consequently, it is essential to operate the grid with a focus on the security measures. Security constrained optimal power flow (SCOPF) imposes additional security constraints to the optimal power flow problem. It aims for minimum adjustments in the pre-contingency operating state, such that in the event of any contingency, the operation will remain secure and within operating limits. For a realistic power network, however, with numerous contingencies considered, the overall problem size becomes intractable for single-core optimization tools in short time frames for real-time industrial operations, such as real-time electricity market responses to electricity prices. We propose a distributed primal-dual interior-point framework exploiting the block-structured KKT linear system arising from the SCOPF problem using a Schur complement technique [2]. In order to utilize node-level parallelism, an incomplete augmented multicore sparse factorization is used, which further exploits sparse structure of the problem. The performance of the implementation is evaluated on the "Piz Daint" supercomputer.

References

[1] D. Kourounis, A. Fuchs and O. Schenk. *Towards the next generation of multiperiod optimal power flow solvers*, IEEE Transactions on Power Systems, PP(99):1-1, 2018.

[2] C. G. Petra, O. Schenk and M. Anitescu. *Real-time stochastic optimization of complex energy systems on high-performance computers*, Computing in Science Engineering, **16**(5):32-42, 2014.

[1] We gratefully acknowledge financial support from the Swiss Commission for Technology and Innovation (CTI - SCCER program). This project is carried out in the frame of the Swiss Centre for Competence in Energy Research on the Future Swiss Electrical Infrastructure (SCCER-FURIES).