# Recent advances in power systems stability analysis

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Transient stability assessment is one of the most computationally intensive problems in power systems. At the same time, the ability to analyze the stability in real-time is essential for secure operation of Special Protection Systems. The straightforward approach is based on intensive time-domain simulations of the transient dynamics, its application for large-dimensional systems is computationally exhaustive. On the other hand, direct methods allow fast contingency screening via provable stability certificates [1].

In this work we present the extention of stability assessment technique [2] that generalize the well-known equal-area criterion for multidimensional case. Operating with the family of quadratic Lyapunov Functions constructed by linear matrix inequalities [3] we exploit its variety for adaptive construction of certificates for particular contingency. In particular, we restrict nonlinear terms with sector bounds and exploit the theory of Lurie systems with multiple nonlinearities. Following this approach the phase difference between any pair of connected generators can be bounded independently and we may pose tighter bounds for strongly coupled generators and simultaneously relax the bounds for weakly coupled pairs.

The database of certificates can be calculated in a pre-processing step, then it can be used for online stability guarantees. We compare this technique with a more well-known energy method approach and demonstrate how adaptive change of sector bounds reduces conservatism. Several strategies for synthesis of optimal remedial action schemes will be proposed and analyzed.

## References

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