Reliable Power Flow Analysis of Systems with Uncertain Data

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Abstract

The load flow is the most basic tool for investigating the requirements and understanding the performance of a power system with fixed values of transmission line parameters and for specified sets of load and generation values. The common formulation of the power flow problem has all the input data specified at a specific time and conditions with fixed values. However, these data are approximate and do not take the measurement errors in transmission line and variation in load demand into consideration. When the input conditions are uncertain, a reliable load flow solution is needed that incorporates the effect of data uncertainty.

This paper addresses the problem of uncertainties in the input parameters by specifying them as compact intervals, taking into consideration the errors in modeling and measurement of transmission line parameters and also the continuous influence of load measurement errors and fluctuation in the demand. The load flow or power flow equations are modeled as a set of nonlinear algebraic equations. These systems of equations are first linearized using Taylor Series expansion and the solution is obtained by the Krawczyk's method of interval arithmetic; see Barboza and and Reiser (2004) and Hansen (1992).

The proposed methodology is implemented in Matlab environment using the Intlab toolbox. The method is applied to 3 bus, 14 bus, 30 bus and 57 bus IEEE test systems. The results obtained are bounded and contain the results obtained by the conventional methods with the input parameters as crisp values. These results are then compared with those obtained with another iterative method for solving interval linear equation systems.

References

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