Interval Analysis of the Load Flow Problem Implemented in C-XSC

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ABSTRACT

Currently a reliable and economical analysis of power systems is essential for their operation. The loads at buses are usually uncertain since they can vary in a fast and disordered way. Besides, the real power generation is measured through instruments, which have usual errors associated to them. It is desirable to study and develop a reliable methodology in order to deal with load and generation uncertainties in electric power flows. We attempt the solution of the following problems: (a) What is the influence of the load measurement errors on the voltage profile in a power electric system? (b) How can we estimate the voltage profile behavior under a load variation in a given period of time? The solution of problem (a) is a classic task of Interval Mathematics. Regarding problem (b) and considering that both minimum and maximum load values in a specific period of time can be estimated, it is possible to evaluate the respective minimum and maximum voltage levels using a traditional power flow analysis [1]. However, if an interval approach is used to deal with the whole interval of load variation, then all possible combinations of load values at all system buses are taken into account. In this sense, the former conventional analysis (i.e., just considering both minimal and maximal values) is a particular case. In addition, interval methods are conservative and provide automatically verified results, that is, interval voltages that include all possible punctual results and computational errors. One of the main applications of our methodology is in expansion planning studies. In such cases, the specialists can use their experience in order to model several load level possibilities in the electric systems. Using an interval load flow program, they can analyze all possible voltage profiles to operate the electric power system in a safe and economic way. It is important to point out that there are others methodologies to deal with uncertainty in power flow analysis, for instance, probabilistic power flow approaches. Our study aims to offer another kind of approach for the same problem, also presenting a comparison study. In order to assess the reliability of the proposed methodology, we have analyzed the results for a realistic electric power system. The implementation is carried out using C-XSC. In previous work we analyzed IEEE-test systems in the Matlab environment using IntLab toolbox [2, 3]. This work is partially supported by FAPERGS and CNPq.

References

