ABSTRACT

The essential requirements for any on-line state estimator are high reliability and low computational burden (speed and storage). This has motivated a search for faster and reliable state estimators that are suitable for well- as well as ill-conditioned power systems.

In this thesis, efficient and effective static state estimation methods for the real-time monitoring of power systems are developed and investigated. The new estimators involve the application of rotational operators to the state and measurement functions resulting in an automatic decoupling of the active and reactive equations. The off-diagonal blocks of the gain and Jacobian matrices become zero and are not omitted. In the existing fast decoupled state estimators, the off-diagonal blocks of the Jacobian/gain matrix are assumed to be zero in order to get a decoupled solution algorithm. The new algorithms do not neglect resistances and have the Jacobian and gain matrices which are composed of the module of the nodal admittance matrix. The new estimators are called the fast super decoupled state (FSDS) estimator and the single-matrix state (SMS) estimator. The SMS estimator is derived from the FSDS estimator incorporating some approximations.

In the FSDS and SMS methods, the Jacobian and gain matrices are made independent of the rotation angles. However, the rotation angles are involved in the iterative process. A solution is obtained through alternately iterating the active and reactive equations using the constant gain matrix and avoiding the approximation due to the decoupling of the Jacobian matrix. Moreover, the SMS algorithm uses only one information matrix to solve the state estimation problem.

The characteristics of the proposed algorithms are ascertained on a number of test systems with low and high R/X ratio lines, ill-conditioning, variable reference voltage, mesh and radial structures, etc. The new algorithms are found to be efficient and effective. They seem to be superior to the available popular versions of the fast decoupled state estimator.