Dynamic estimation of power system stability in different Kalman filter implementations

Abstract

Voltage collapse is still the biggest threat to the transmission system. There are many approaches that have been explored to predict the point of voltage collapse. However, it is still lacking of information that related to current system state. With the advancement of Phasor Measurement Units (PMUs) technology, it provides an alternate pathway to improve the existing power system state estimation. Hence, it was of interest to develop better methods that could give a preliminary warning before the voltage collapse. This paper concerns for the development of real-time system monitoring methods to give a timely warning in the power system. The algorithm to predict the points of collapse is based on the assumption that voltage instability is closely related to the maximum load ability of a transmission network. Therefore, the Thevenin impedance is equalled to the apparent load impedance at the points of collapse. Numerous methods such as Discrete Kalman Filter (DKF), Extended Kalman Filter (EKF) and Unscented Kalman Filter (UKF) are being implemented into the realtime voltage instability predictor to track the Thevenin parameters. The test results are tested on Malaysia's power system 132 kV - 2-bus and 10-bus systems. The results are compared based on the early-warning index of voltage collapse. The results of DKF method are set as the reference for comparison purpose between EKF method and UKF method. The test results shown that EKF method provided better results by decreasing of 0.1169 p.u. for 2-bus system and 0.0338 p.u. for 10-bus system. In the meanwhile, UKF method provided increasing values of 0.4262 p.u. for 2-bus system and 0.1522 p.u, for 10-bus system. The overall purpose of this research is to develop methods that in provide early warning for an emerging stability problem. In order to achieving the research's objectives, derivation of the index for early warning of the point of collapse is completed. The performance of each method used throughout this research is based on the analyzed results for the points of voltage collapse.