**Title:**

Fast Calculation of Thevenin Equivalents for the real time steady state voltage stability estimation

**Abstract:**

The purpose of this work is to present a novel approach to quickly update Thevenin equivalents of multi nodal systems, which can be used to calculate long-term Voltage Stability Margins (VSMs) in real-time applications considering n-k contingencies in the grid. To accomplish this, a derivation of Thevenin equivalent parameters of a multi-port system is proposed, which are expressed in terms of the parameters of the Zbus of the network. Then, by using the matrix inversion lemma and Kron reductions, a new methodology to quickly update the Zbus of the system when n-k contingencies occur is explained. The speed of this approach is due to the avoidance of inversion of matrices required when Thevenin equivalents are calculated using information of the Ybus. Instead of this, only matrix multiplications between Zbus and other vectors are needed to obtain the parameters of Thevenin equivalents. This approach proposes a solution for some of the current issues associated with the implementation of long-term VSMs in real-time systems.