Abstract

Power systems are facing a gradual reduction of system inertia brought by the increasing installation of power electronic interfaced devices. From a theoretical point of view, it is worth investigating whether low inertia systems can be described using traditional stability transient programs which are based on quasi-static phasors. After large disturbances in low inertia system, the electrical energy is not transmitted at system frequency but also in a narrow band frequency spectrum. In this regard, Dynamic Phasors according to Shifted Frequency Analysis (SFA) appears to be a promising modelling technique. They incorporate more dynamics into the models and, at the same time, allow to use relatively large step sizes so that they seem suitable for the simulation of large scale low inertia systems. The aim of this thesis is on implementing reduced order synchronous generator models typically used in transient stability programs in a real-time simulator in the time, static phasor and dynamic phasor domain. For this purpose, new voltage behind reactance (VBR) implementations of the reduced order synchronous generator models are proposed. The accuracy and computational efficiency of the proposed VBR implementations is compared with the traditional implementations based on the partitioned-solution interfacing approach typically described in literature. Furthermore, the accuracy of the dynamic phasor models is compared with the implementations in the static phasor domain used in the conventional transient stability programs for both classical and low inertia systems. At the same time, the limitation of Static Phasor for low inertia systems is demonstrated.

Keywords: Synchronous Generator Modelling, Dynamic Phasor Modelling, Low Inertia, Voltage Behind Reactance