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Applicability of Linearized Model of Synchronous Generator for Power System Stability Analysis

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Abstract : For the synchronous generator simulation and analysis and for the power system stabilizer design and synthesis a mathematical model of synchronous generator is needed. The model has to accurately describe dynamics of oscillations, while at the same time has to be transparent enough for an analysis and sufficiently simplified for design of control system. To study the oscillations of the synchronous generator against to the rest of the power system, the model of the synchronous machine connected to an infinite bus through a transmission line having resistance and inductance is needed. In this paper, the linearized reduced order dynamic model of the synchronous generator connected to the infinite bus is presented and analysed in details. This model accurately describes dynamics of the synchronous generator only in a small vicinity of an equilibrium state. With the digression from the selected equilibrium point the accuracy of this model is decreasing considerably. In this paper, the equations’ descriptions and the parameters’ determinations for the linearized reduced order mathematical model of the synchronous generator are explained and summarized and represent the useful origin for works in the areas of synchronous generators’ dynamic behaviour analysis and synchronous generator’s control systems design and synthesis. The main contribution of this paper represents the detailed analysis of the accuracy of the linearized reduced order dynamic model in the entire synchronous generator’s operating range. Borders of the areas where the linearized reduced order mathematical model represents accurate description of the synchronous generator’s dynamics are determined with the systemic numerical analysis. The thorough eigenvalue analysis of the linearized models in the entire operating range is performed. In the paper, the parameters of the linearized reduced order dynamic model of the laboratory salient poles synchronous generator were determined and used for the analysis. The theoretical conclusions were confirmed with the agreement of experimental and simulation results.

Keywords : eigenvalue analysis, mathematical model, power system stability, synchronous generator
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