Determination of Synchronous Generator Nonlinear Model Parameters Based on Power Rejection Tests Using a Gradient Optimization Algorithm

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Abstract

In the paper, there is presented a method for determining electromagnetic parameters of different synchronous generator models based on dynamic waveforms measured at power rejection [1, 2, 3, 4]. Such a test can be performed safely under normal operating conditions of the generator working in a power plant. There were investigated the generator model expressed by reactances and time constants of steady, transient and subtransient state in the d and q axis as well as the circuit models (type (3,3) and (2,2)) expressed by resistances and inductances of stator, excitation and equivalent rotor damping circuits windings [1, 3, 5]. All these models take approximately into account the influence of magnetic core saturation. The least squares method was used for parameter estimation. There was minimized the objective function defined as the mean square error between the measured waveforms and the waveforms calculated based on the mathematical models [3, 4]. A method of determining the initial values of the state variables which also depend on the searched parameters is presented. To minimize the objective function, a gradient optimization algorithm finding local minima for a selected starting point was used. To get closer to the global minimum, calculations were repeated many times when taking into account the inequality constraints for the searched parameters. In the paper, there are presented the parameter estimation results and comparison of the waveforms measured and calculated based on the final parameters for 200 MW and 50 MW turbogenerators.

References

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