Guidelines for Student Reports

Implementation of an Optimal Power Flow algorithm based on the Newton's method

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Abstract

The Optimal Power Flow (OPF) problem was firstly presented by Carpentier in the early 1960s and it has been one of the most widely studied subjects in the power system community. The objective of an Optimal Power Flow (OPF) algorithm is to find a steady state operation point which minimizes generation cost, network loss etc. or maximizes social welfare or system utilization etc. while maintaining an acceptable system performance in terms of limits on generators active and reactive powers, line flow limits, maximum output of various compensating devices etc..
The OPF can be formulated mathematically as a general constrained optimization problem. More in detail, it can ve described as: min F(u,x) s.t. h(u,x) = 0
g(u,x) <= 0 where, u is the set of controllable variables in the system and x is the set of dependent variables. For example, u consists of generator voltage, generator active power output except at the slack bus, transformer tap settings and shunt VAR compensations; x consists of slack bus power, load bus voltages, generator reactive power outputs and transmission line loadings. F(u,x) is an objective function which is a scalar. Equality constraint h(u,x) are derived from conventional power balance equations. Inequality constraints g(u,x) are the limits on control variables u and the operating limit on the other variables of the system. The goal of this project is the implementation and the test of the Optimal Power Flow (OPF) algorithm described in the work of Dommel et al., in which the OPF problem has been solved by means of the Newton method. Such a work consider different problems with increasing difficult that should be solved. Moreover, an interesting and complete introduction about the Newton method can be found in the literature.

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