

电力系统仿真及分析计算

最优协调电压控制准稳态模型及其直接动态优化方法

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摘要:

根据准稳态模型, 将协调电压控制问题表示为含连续 - 离散时间的微分 - 代数方程约束的最优控制模型, 并采用现代最优控制理论中的直接法求解该动态优化问题。利用排列法将研究时间段划分为有限个区间, 将所有状态变量、代数变量和控制变量在每个区间内用一系列多项式近似, 从而将动态优化问题转化为非线性规划问题。为考虑有载调压变压器变比、可投切电容器组以及负荷切除的离散控制特性, 引入二次罚函数处理离散变量, 并采用非线性原对偶内点算法求解模型。从新英格兰10机39节点系统的仿真结果看出, 该方法能求出有效控制以增强系统的长期电压稳定性。

关键词: 准稳态模型 直接动态优化法 排列法 非线性原对偶内点算法 离散控制

Quasi-steady State Model of Optimal Coordinated Voltage Control and Its Direct Dynamic Optimization Approach

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Abstract:

According to quasi-steady state model, the coordinated voltage control problem was represented by an optimization model subjected to differential-algebraic equations with continuous-discrete time variables. A direct dynamic optimization approach from modern control theories was introduced into solution of the dynamic optimization. The dynamic optimization problem can be formulated as a nonlinear programming by approximating state variable, algebraic variable and control variable profiles by a family of polynomials on finite time intervals. Considering the discrete control characteristics of the ratios of transformers with on-load tap changers, shunt capacitors and load shedding, a quadratic penalty function was introduced to handle corresponding discrete variables. The primal-dual interior point strategy was applied to solve this nonlinear programming model. The simulation results on New England 10-machine 39-bus system show that the proposed approach can determine effective controls to enhance long-term voltage stability of power systems largely.

Keywords: quasi-steady state model direct dynamic optimization approach collocation method nonlinear primal-dual interior point algorithm discrete control

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