

电力系统

单相H桥级联静止同步补偿器反馈线性化解耦控制

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摘要:

单相H桥级联静止同步补偿器(static synchronous compemator, STATCOM)可以快速补偿电力机车这种单相整流的波动性负荷所需的无功, 但静止同步补偿器是一个强耦合、非线性系统, 为对有功和无功进行解耦, 引入反馈线性化方法, 通过坐标变化和状态反馈, 获得精确线性化模型, 并使有功、无功完全解耦, 设计完成闭环控制器。为保持H桥直流侧电容电压均衡, 采用电压外环和独立均压控制相结合的方法, 使电容电压维持在设定值。同时, 采用载波相移正弦脉宽调制策略(carrier phase-shifted sinusoidal pulse- width modulation, CPS-SPWM), 在较低的器件开关频率下实现较高等效开关频率。数值仿真结果表明, 本文采用控制策略正确有效, 系统有功和无功功率可独立调节, 动态性能良好, 电容电压能稳定在设定值。

关键词: 单相级联H桥 静止同步补偿器 精确反馈线性化 独立均压控制 载波相移正弦脉宽调制

Control Scheme of Decoupled State Feedback Linearization of Single-Phase H-Bridge Cascaded STATCOM

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Abstract:

Electric locomotive is a kind of single-phase rectified and fluctuating load, and single-phase H-bridge cascaded static synchronous compensator (STATCOM), which is a strongly coupled nonlinear system, can be applied to electrical railway system to compensate reactive power. To decouple active and reactive power, through leading in feedback linearization method and by means of coordinate transformation and state feedback, active and reactive power are completely decoupled and an precise linearization model is attained, and a closed-loop controller is developed. To keep capacitance voltage balancing at DC side of H-bridge, the outer voltage loop is combined with individual balancing control to make capacitance voltage keeping its set value. Meanwhile, adopting the strategy of carrier phase-shifted sinusoidal pulse-width modulation (CPS-SPWM), a higher equivalent switching frequency is implemmented under lower device switching frequency. Numerical simulation results show that the proposed control strategy is correct and effect; active and reactive power can be independently adjusted and dynamic performance of the system is satisfied, and the set value of capacitor voltage can be maintained.

Keywords: single-phase cascaded H-bridge static synchronous compensator (STATCOM) exact feedback linearization individual balancing control carrier phase- shifted sinusoidal pulse-width modulation (CPS-SPWM)

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