电源学报
JOURNAL OF POWER SUPPLY
北大中文核心期刊
ISSN 2095-2805 CN 12-1420/TM

电源学报 ›› 2023, Vol. 21 ›› Issue (1) : 99-106. DOI: 10.13234/j.issn.2095-2805.2023.1.99

并网逆变器

电网不平衡下并网逆变器的矢量比例积分控制

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Vector Proportional Integral Control of Grid-connected Inverter under Unbalanced Grid

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摘要

当电网电压发生不平衡故障时,逆变器的输出电流会发生畸变。通过分析电网电压不平衡下逆变器的网侧数学模型,提出了一种基于矢量比例积分VPI（vector proportional integral）控制器的PI-VPI（proportional integral-vector proportional integral）控制策略。通过系统开环、闭环的Bode图对PI-VPI控制器性能进行分析,发现相比于传统的比例谐振PR（proportional resonance）控制策略,PI-VPI控制器可确保闭环电流控制达到谐振频率处期望的0°相位响应,提高电流闭环控制的稳定性与控制精度。设计了PI-VPI控制器参数。仿真与实验结果表明,该方法能有效抑制电网电压不平衡引起的输出电流畸变。

Abstract

The distortion of output current from an inverter will occur under unbalanced grid voltage faults. Through the analysis of the mathematical model of a grid-side inverter under unbalanced grid voltage, a proportional in-tegral-vector proportional integral （PI-VPI） control strategy based on a VPI controller is proposed. Based on the performance analysis of the PI-VPI controller by means of the open-loop and closed-loop Bode diagrams of the system, it is found that compared with the traditional proportional resonance （PR） control strategy, the PI-VPI controller can ensure that the closed-loop current control reaches the desired 0° phase response at the resonance frequency, thus improving the stability and control accuracy of the current closed-loop control. The parameters of the PI-VPI controller are designed, and simulation and experimental results prove that the proposed method can effectively suppress the output current distortion caused by the unbalanced grid voltage.

关键词

不平衡电网 / PI-VPI控制器 / 并网逆变器 / 直接电流控制

Key words

unbalanced grid / PI-VPI controller / grid-connected inverter / direct current control

引用本文

导出引用

王素娥, 王子婷, 郝鹏飞. 电网不平衡下并网逆变器的矢量比例积分控制. *电源学报*. 2023, 21(1): 99-106 https://doi.org/10.13234/j.issn.2095-2805.2023.1.99

WANG Sue, WANG Ziting, HAO Pengfei. Vector Proportional Integral Control of Grid-connected Inverter under Unbalanced Grid. *Journal of Power Supply*. 2023, 21(1): 99-106 https://doi.org/10.13234/j.issn.2095-2805.2023.1.99

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基金

陕西省科技厅资助项目（2018XNCG-G-12）；西安市科技计划资助项目（2020KJRC0001）