



ISSN 1000-6753

CN 11-2188/TM

半月刊

SEMIMONTHLY

# 电工技术学报

TRANSACTIONS OF  
CHINA ELECTROTECHNICAL SOCIETY



中国电工技术学会主办

2017年 第22期

第32卷 Vol.32 No.22

ISSN 1000-6753



# 电工技术学报

2017年 第32卷 第22期

## 目 次

### 电力电子与电力传动

- 1 基于调制波重构的级联 H 桥型变流器直流电压均衡控制原理分析 ..... 吴丽然 吴命利
- 13 H 桥级联型多电平高压调速系统低速畸变补偿控制技术 ..... 张 亮 陈国栋 朱纪洪 袁宇波 永恒华
- 22 基于漏感补偿的可变恒流输出补偿网络参数确定方法及其特性分析 ..... 陈庆彬 张伟豪 欧阳奕欣 陈 为
- 34 无线电能传输用 S/CLC 补偿拓扑分析 ..... 王懿杰 姚友素 刘晓胜 徐殿国
- 42 二阶广义积分器的三种改进结构及其锁相环应用对比分析 ..... 张纯江 赵晓君 郭忠南 于安博
- 50 压接式 IGBT 模块的动态特性测试平台设计及杂散参数提取 ..... 刘盛福 常 垚 李武华 杨 欢 赵荣祥
- 58 有限集模型预测控制在电力电子系统中的研究现状和发展趋势 ..... 柳志飞 杜贵平 杜发达

### 电机与电器

- 70 低分辨率位置传感器永磁同步电机精确位置估计方法综述 ..... 倪启南 杨 明 徐殿国 刘晓胜
- 82 基于反推控制的机械弹性储能永磁同步电机最大转矩电流比控制 ..... 余 洋 郭旭东 郑晓明 米增强
- 91 全封闭高速永磁电机转子结构对转子散热的影响 ..... 佟文明 孙静阳 吴胜男
- 101 大功率高速永磁电机柔性转子系统模态分析 ..... 杜光辉 黄 娜 张凤阁 王天煜
- 108 双 V 型结构削弱永磁直线电机磁阻力波动方法 ..... 彭 兵 李丽萍 张 囡 赵国新 刘铁法
- 115 变压器空载电流谐波低频测量方法 ..... 姚陈果 刘 鑫 胡 迪 万佳伦 王俊凯
- 123 双向全桥 DC-DC 变换器中大容量高频变压器绕组与磁心损耗计算 ..... 陈 彬 李 琳 赵志斌

### 电工理论与新技术

- 134 高压自耦变压器肺叶磁屏蔽特性的数值计算与分析 ..... 李龙女 李 岩 刘晓明
- 144 电磁超声管道周向兰姆波仿真分析及缺陷检测特性研究 ..... 刘素贞 张严伟 张 闯 金 亮 杨庆新
- 152 电动汽车无线充电电磁环境安全性研究 ..... 徐桂芝 李晨曦 赵 军 张 献
- 158 多通道经颅磁刺激线圈阵列的驱动与控制 ..... 李江涛 曹 辉 郑敏军 赵 政
- 166 面向舰船装备的电工软磁材料精细模拟技术综述 ..... 陈俊全 王 东 陈志华 虞志书 曾 春

### 电力系统及其自动化

- 176 一种交直流混合微网能量路由器及其运行模态分析 ..... 涂春鸣 孟 阳 肖 凡 兰 征 帅智康
- 189 基于小波包分解-概率模糊集特定策略下马尔可夫决策过程的微电网公共耦合点功率优化控制  
..... 熊 雄 王江波 杨仁刚
- 198 连接低惯量系统的柔性直流输电模型预测控制 ..... 韩民晓 翟冬玲 唐晓骏

- 207 基于电压源换流器 HVDC 联网的受端电网扩展黑启动方案····· 杨 超 梁海平 顾雪平 张 丹 刘旭斐
- 216 低电压穿越控制下双馈风电机组短路电流特性与计算方法····· 欧阳金鑫 唐 挺 郑 迪 任文君 熊小伏等
- 225 基于虚拟惯量和频率下垂控制的双馈风电机组一次调频策略····· 张冠锋 杨俊友 孙 峰 戈阳阳 邢作霞
- 233 基于自适应 EEMD 和分层分形维数的风电机组行星齿轮箱故障检测····· 李东东 周文磊 郑小霞 王 浩
- 242 电动汽车换电站可用电池组数动态调度策略····· 刘灵恺 雷 霞 李 竹 黄贵鸿 雷 海

## 高电压与绝缘技术

- 251 直流大功率继电器电弧研究综述····· 翟国富 薄 凯 周 学 张 勇
- 264 高频纳秒脉冲串作用下皮肤肿瘤热效应的多参数有限元仿真与实验  
····· 米 彦 彭文成 芮少琴 况东东 罗 庆

# TRANSACTIONS OF CHINA ELECTROTECHNICAL SOCIETY

2017 Vol.32 No.22

## Contents

- 1 Principle of DC Voltage Balancing Control Strategy Based on Modulation Signal Reconstruction for Cascaded H-Bridge Converter ..... Wu Liran Wu Mingli
- 13 Distortion Compensation Control Designed for H-Bridge Cascade Multi-Level Converter under Low Speed Condition ..... Zhang Liang Chen Guodong Zhu Jihong Yuan Yubo Shui Henghua
- 22 A Design Method for Compensation Network Parameters with Variable Constant Current Output and its Characteristics Analysis Based on Leakage Inductance Compensation ..... Chen Qingbin Zhang Weihao Ouyang Yixin Chen Wei
- 34 Analysis on S/CLC Compensation Topology for Wireless Power Transfer ..... Wang Yijie Yao Yousu Liu Xiaosheng Xu Dianguo
- 42 Three Improved Second Order Generalized Integrators and the Comparative Analysis in Phase Locked Loop Application ..... Zhang Chunjiang Zhao Xiaojun Guo Zhongnan Yu Anbo
- 50 Dynamic Switching Characteristics Test Platform Design and Parasitic Parameter Extraction of Press-Pack IGBT Modules ..... Liu Shengfu Chang Yao Li Wuhua Yang Huan Zhao Rongxiang
- 58 Research Status and Development Trend of Finite Control Set Model Predictive Control in Power Electronics ..... Liu Zhifei Du Guiping Du Fada
- 70 Review of Precise Position Estimation Method of PMSM with Low-Resolution Position Sensor ..... Ni Qinan Yang Ming Xu Dianguo Liu Xiaosheng
- 82 Backstepping Control Based Maximum Torque Per Ampere Control of Permanent Magnet Synchronous Motor for Mechanical Elastic Energy Storage ..... Yu Yang Guo Xudong Zheng Xiaoming Mi Zengqiang
- 91 Effect of Rotor Structure on Rotor Dissipation for Totally-Enclosed High-Speed Permanent Magnet Motor ..... Tong Wenming Sun Jingyang Wu Shengnan
- 101 Modal Analysis of the Flexible Rotor System for High-Power High-Speed Permanent Magnet Machine ..... Du Guanghui Huang Na Zhang Fengge Wang Tianyu
- 108 A Method for Reducing Detent Force Fluctuation by Double-V-Shaped Structure in Permanent Magnet Linear Motor ..... Peng Bing Li Liping Zhang Nan Zhao Guoxin Liu Tiefu
- 115 No-Load Current Harmonics Measurement of Transformers Using Low-Frequency Method ..... Yao Chenguo Liu Xin Hu Di Wan Jialun Wang Junkai
- 123 Calculation of High-Power High-Frequency Transformer's Copper Loss and Magnetic Core Loss in Dual-Active-Bridge DC-DC Converter ..... Chen Bin Li Lin Zhao Zhibin
- 134 Numerical Calculation and Analysis of Lobe-Type Magnetic Shielding in High Voltage Auto-Transformer ..... Li Longnu Li Yan Liu Xiaoming
- 144 Research on Simulation Analysis of Electromagnetic Ultrasonic Circumferential Lamb Waves and Defect Feature Detection in Pipeline ..... Liu Suzhen Zhang Yanwei Zhang Chuang Jin Liang Yang Qingxin
- 152 Electromagnetic Environment Safety Study of Wireless Electric Vehicle Charging ..... Xu Guizhi Li Chenxi Zhao Jun Zhang Xian
- 158 The Drive and Control of Multi-Channel Transcranial Magnetic Stimulation Coil Array ..... Li Jiangtao Cao Hui Zheng Minjun Zhao Zheng



- 166 Review of Precise Modeling Technology of Electrical Soft Magnetic Material Applied in Vessel Equipment  
 ..... Chen Junquan Wang Dong Chen Zihua Yu Zhishu Zeng Chun
- 176 An AC-DC Hybrid Microgrid Energy Router and Operational Modal Analysis  
 ..... Tu Chunming Meng Yang Xiao Fan Lan Zheng Shuai Zhikang
- 189 Microgrid PCC Power Optimal Control with Markov Decision Process Using the Specific Policy of  
 Wavelet Packet-Probability Fuzzy Set ..... Xiong Xiong Wang Jiangbo Yang Rengang
- 198 Model Predictive Control of Voltage Source Converter-HVDC Connected to Low Inertia System  
 ..... Han Minxiao Zhai Dongling Tang Xiaojun
- 207 The Recovery Strategy of the Extended Black-Start for the Receiving End System Based on  
 the Voltage Source Converter-HVDC ..... Yang Chao Liang Haiping Gu Xueping Zhang Dan Liu Xufei
- 216 Characteristics and Calculation Method of Short-Circuit Current of Doubly Fed Wind Generator under  
 Lower Voltage Ride Through ..... Ouyang Jinxin Tang Ting Zheng Di Ren Wenjun Xiong Xiaofu et al
- 225 Primary Frequency Regulation Strategy of DFIG Based on Virtual Inertia and Frequency Droop Control  
 ..... Zhang Guanfeng Yang Junyou Sun Feng Ge Yangyang Xing Zuoxia
- 233 Diagnosis of Wind Turbine Planetary Gearbox Faults Based on Adaptive EEMD and Hierarchical Fractal Dimension  
 ..... Li Dongdong Zhou Wenlei Zheng Xiaoxia Wang Hao
- 242 Dynamic Scheduling Strategy for Available Battery Number of Electric Vehicle in Battery-Swap Station  
 ..... Liu Lingkai Lei Xia Li Zhu Huang Guihong Lei Hai
- 251 Investigation on Breaking Arc in DC High-Power Relays: A Review ..... Zhai Guofu Bo Kai Zhou Xue Zhang Yong
- 264 Thermal Effects in Skin Tumor Exposed to High-Frequency Nanosecond Pulse Bursts: Multi-Parametric Finite  
 Element Simulation and Experiment ..... Mi Yan Peng Wencheng Rui Shaoqin Kuang Dongdong Luo Qing