电网技术 2010, 34(7) 25-29 DOI: ISSN: 1000-3673 CN: 11-2410/TM

国家重点基础研究项目

交流牵引供电系统仿真通用数学模型及其应用

何俊文,李群湛,刘炜,周晓辉

西南交通大学 电气工程学院，四川省 成都市 610031

摘要：

对交流牵引供电系统进行统一的数学建模，是实现数字化仿真的关键。以多导体传输线模型为基础，构建了适用于不同供电方式的牵引网统一数学模型；基于牵引变电所端口电气量通用变换关系，推导了适用于不同变压器接线形式和不同相序接入的牵引变电所通用等值电路；在链式网络结构的基础上，建立了交流牵引供电系统仿真通用数学模型，并改进潮流计算方法。以此为基础，开发交流牵引供电仿真软件。实例计算表明，该模型具有良好的通用性和较高的精确度，适用于高速、重载电气化铁道牵引供电系统仿真。

关键词：

General Mathematical Model for Simulation of AC Traction Power Supply System and Its Application

HE Jun-wen ,LI Qun-zhan ,LIU Wei ,ZHOU Xiao-hui

School of Electrical Engineering, Southwest Jiaotong University, Chengdu 610031, Sichuan Province, China

Abstract:

A unified mathematical modeling for AC traction power supply system is the key to the implementation of digital simulation. Based on the model of multi-conductor transmission line, a general mathematical model suitable to traction power networks fed by different power supply modes is established. According to general transform relation among terminal electric quantities of traction substation, the general equivalent circuit suitable to traction substation connected to different winding connection modes of transformers and different phase sequences. Based on chain network structure, a general mathematical model for the simulation of AC traction power supply system is built and the method to calculate power flow is improved. On this basis, the simulation software for AC traction power supply is developed. Calculation results of actual example show the built model possesses good generality and higher simulation accuracy, so it is suitable to the simulation of traction power supply system for high-speed and heavy-haul electrified railway.

Keywords:

收稿日期 2009-09-14 **修回日期** 2009-12-14 **网络版发布日期** 2010-07-13

DOI:

基金项目:

“十一五”国家科技支撑计划重大项目(2007BAA12B05)。

通讯作者: 何俊文

作者简介:

作者Email: hjw_swjtu@139.com

参考文献：

[1] 何正友，方雷，郭东，等．基于AT等值电路的牵引网潮流算法[J]．西南交通大学学报，2008(2)：1-6． He Zhengyou，Fang Lei，Guo Dong，et al．Algorithm for power flow of electric tracoon network based on equivalent circuit of AT-Fed system[J]．Journal of Southwest Jiaotong University，2008(2)：1-6(in Chinese)． [2] 万庆祝，吴命利，陈建业，等．基于牵引计算的牵引变电所馈线电流仿真计算[J]．电工技术学报，2007(6)：108-113． Wan Qingzhu，Wu Mingli，Chen Jianye，et al．Simulating calculation of traction substation's feeder current based on traction calculation[J]．Transactions of China

Electrotechnical Society，2007(6)：108-113(in Chinese)． [3] 张小瑜，吴俊勇．电气化铁道接入电力系统电压等级问题[J]．电网技术，2007，31(7)：12-17． Zhang Xiaoyu，Wu Junyong．Research on voltage class of power system to be connected with electrified railways[J]．Power System Technology，2007，31(7)：12-17(in Chinese)． [4] Cai Y，Irving M R，Case S H．Compound matrix partitioning and modification for the solution of branched autotransformer traction feeds[J]．IEE Proc-Electr Pnwer Appl，1996，143(3)：251-257． [5] Goodman C J，Kulworawanichpong T．Sequential linear power flow solution for AC electric railway power supply systems[J]．Computers in Railways VIII，2002，61(13)：531-540． [6] 李群湛，贺建闽．牵引供电系统分析[M]．成都：西南交通大学出版社，2007：12-14． [7] 张丽艳，李群湛，解邵峰，等．星形—开闭三角形接线平衡变压器的阻抗匹配与数学模型[J]．电网技术，2009，33(12)：31-34． Zhang Liyan，Li QunZhan，Xie Shaofeng，et al．Impedance matching and mathematical model of ynvd connected balance transformer[J]．Power System Technology，2009，33(12)：31-34(in Chinese)． [8] 吴命利，范喻．星形延边三角形接线平衡变压器的阻抗匹配与数学模型[J]．中国电机工程学报，2004，24(11)：160-166． Wu Mingli，Fan Yu．Impedance matching and mathematical model of wye-prolonged delta connected balance transformer[J]．Proceedings of the CSEE，2004，24(11)：160-166(in Chinese)． [9] 李群湛．牵引变电所供电分析及综合补偿技术[M]．北京：中国铁道出版社，2006：5-14． [10] 张力强，罗文杰，吕利军．电气化铁路牵引负荷的不利影响及治理方案[J]．电网技术，2005，29(17)：82-84． Zhang Liqiang，Luo Wenjie，Lü Lijun．Disadvantage and manage project on electrization railway draught load[J]．Power System Technology，2005，29(17)：82-84(in Chinese)． [11] 姚金雄，张涛，林榕，等．牵引供电系统负序电流和谐波对电力系统的影响及其补偿措施[J]．电网技术，2008，32(9)：61-64． Yao Jinxiong，Zhang Tao，Lin Rong，et al．Impacts of negative sequence current and harmonics in traction power supply system for electrified railway on power system and compensation measures[J]．Power System Technology，2008，32(9)：61-64(in Chinese)． [12] 周勇，刘中元．牵引变电站的220 kV三相供电方案[J]．电网技术，2005，29(17)：81-84． Zhou Yong，Liu Zhongyuan．220 kV three-phase power supply scheme of traction substation[J]．Power System Technology，2005，29(17)：81-84(in Chinese)． [13] 池云莉，何天健，梁嘉杰．电气化铁道系统概率潮流算法研究[J]．电气化铁道，2004(6)：4-8． Chi Yunli，He Tianjian，Liang Jiajie．Research on probabilistic load flow of AC electrified railway system[J]．Electric Railway，2004(6)：4-8(in Chinese)． [14] Ho T K，Chi Y L，Wang J．Probabilistic load flow in AC electrified railways[J]．IEEE Proc Electr Power Appl，2005，152(4)：1003-1013． [15] 郭东，杨建伟，何正友，等．一种基于牛顿法的交流高速铁路牵引供电潮流计算方法的研究[J]．继电器，2007，35(18)：16-29． Guo Dong，Yang Jianwei，He Zhengyou，et al．Research on a flow analysis method of power supply system for AC high speed railway based on Newton method[J]．Relay，2007，35(18)：16-29(in Chinese)． [16] 张进思．电牵引负荷谐波的分布计算[M]．成都：西南交通大学出版社，1989：11-19． [17] 吴命利．牵引供电系统电气参数与数学模型研究[D]．北京：北京交通大学，2006． [18] 吴命利，李群湛．输电线谐波模型与算法研究[J]．铁道学报，1995，4(17)：105-112． Wu Mingli，Li Qunzhan．A study of harmonic model and its algorithms for transmission lines[J]．Journal of the China Railway Society，1995，4(17)：105-112(in Chinese)．

本刊中的类似文章
