



发光学应用及交叉前沿

基于PSO粒子群算法的LED照明系统光照均匀性研究

赵芝璞, 季凌燕, 沈艳霞, 苏宙平

江南大学 电气自动化研究所, 江苏 无锡 214122

PDF 下载

引用本文

摘要： 实现大功率LED阵列在目标平面上的照度均匀分布对于照明系统具有十分重要的意义。不同于传统解析计算方法，本文采用粒子群（PSO）算法来优化平面随机分布的LED阵列结构，使其在目标光照平面上光照分布均匀。首先推导了LED阵列的照度分布函数，并在此基础上以光照函数的标准差构建一个评价函数，衡量光照分布均匀度。在Matlab中编程获得光照分布最优时候的LED阵列结构数据，并将几何模型导入光学仿真软件Tracepro中进行优化模拟，仿真结果表明该算法有效可行。

关键词： LED阵列 粒子群算法 光照度 均匀化

本刊中的类似文章

1. 基于等效热路法的LED阵列散热性能研究[J]. 2013, 34(4): 516-522
2. 基于PSO粒子群算法的LED阵列优化研究与仿真[J]. .(): 0-0

Research of Illumination Uniformity for LED Arrays Based on PSO Algorithm

ZHAO Zhi-pu, JI Ling-yan, SHEN Yan-xia, SU Zhou-ping

Institute of Electrical Automation, Jiangnan University, Wuxi 214122, China

Abstract: Due to the limitation of single LED, it is of great significance to apply LED arrays to enhance the brightness and enlarge the luminous area to improve the uniformity of illuminance. Different from traditional analytical calculation methods, particle swarm optimization algorithm was proposed to optimize the structure of LED arrays to achieve a good uniform illuminance distribution on the target plane in this paper. Firstly, formulae of illuminance distribution on target plane illuminated by LED arrays were obtained, and then an evaluation function was constructed to measure the uniformity of illuminance distribution. Matlab software was used to calculate the initial structure parameters. Finally, Tracepro optical software was adopted to give an imitation and simulation. The simulation results show that the LED arrays can produce highly uniform illuminance distribution. It indicates that our method is simple and can optimize the LED automatically by computer program.

Keywords: LED arrays particle swarm optimization algorithm illuminance uniformity

收稿日期 2013-06-17 修回日期 2013-08-15 网络版发布日期

基金项目:

国家自然科学基金(61104183); 中央高校基本科研业务费专项资金(JUSRP31106)资助项目

通讯作者: 沈艳霞, E-mail: shenyx@jiangnan.edu.cn

作者简介: 赵芝璞(1976-), 女, 江苏常州人, 主要从事电力电子与电气传动方面的研究。E-mail: zzp_wx@163.com

作者Email: shenyx@jiangnan.edu.cn

参考文献:

- [1] Ding Y, Liu X, Zheng Z R, Gu P F. Freeform LED lens for uniform illumination[J]. *Opt. Exp.*, 2008, 16(17):12958-12966.
- [2] Zhao Y H, Fan C J. Design of combined reflectors used in LED street lamps[J]. *Chin. Opt. (中国光学)*, 2012, 5(5):520-524 (in Chinese).
- [3] Wang K, Liu S, Chen F, et al. Freeform LED lens for rectangularly prescribed illumination[J]. *Opt. A: Pure Appl. Opt.*, 2009, 11(10):105501-1-5.
- [4] Lyu H Y, Liu Y, Xue X C. Difference auto-focusing based on particle swarm optimization searching and wavelet evaluation[J]. *Chin. Opt. (中国光学)*, 2011, 4(3):283-292 (in Chinese).
- [5] Moreno I, Avendano-Alejo M, Tzonchev R I. Designing light-emitting diode arrays for uniform near-field irradiance[J]. *Appl. Opt.*, 2006, 45(10):2265-2272.
- [6] Qin Z, Wang K, Chen F, et al. Analysis of condition for uniform lighting generated by array of light emitting diodes with large view angle[J]. *Opt. Exp.*, 2010, 18(16):17460-17467.
- [7] Hu H L, Lai A G, Xie S S. Studies of illuminance distribution of LED arrays for road illumination[J]. *China Illumin. Eng. J. (照明工程学报)*, 2009, 20(1):77-80 (in Chinese).
- [8] Wang H, Zhang Q H, Wang H H, et al. Design of LED arrays for uniform near-field illumination[J]. *Opt. Optoelect. Technol. (光学与光电技术)*, 2009, 7(5):78-83 (in Chinese).
- [9] Zhou X J, Feng S M. Design of high uniformity LED backlight[J]. *Chin. J. Liq. Cryst. Disp. (液晶与显示)*. 2012, 27(6):774-779

- [10] Whang A J W, Chen Y Y, Teng Y T. Designing uniform illuminance systems by surface-tailored lens and configurations of LED arrays[J]. *Disp. Technol.*, 2009, 5(3):94-103.
- [11] Kennedy J, Eberhart R. Particle swarm optimization[C]//Proc. IEEE Int. Conf. on Neural Networks, Piscataway: IEEE, 1995:1942-1948.
- [12] Su Z P, Qu L Z, Zhu Z W, *et al.* Optical system design of the compact collimator for LED source[J]. *Laser & Optoelectronics Progress* (激光与光电子学进展), 2012, 49(2):022203-1-5 (in Chinese).
- [13] Zheng Z R, Hao X, Liu X. Freeform surface lens for LED uniform illumination[J]. *Appl. Opt.*, 2009, 48(35):6627-6634.
- [14] Su Z P, Xue D L, Ji Z C. Designing LED array for uniform illumination distribution by simulated annealing algorithm[J]. *Opt. Exp.*, 2012, 20(S6):843-855.
- [15] Gui J Z, Chen Y, Miao J, *et al.* Luminance uniformity evaluation for LED display panel based on HVS[J]. *Chin. J. Liq. Cryst. Disp.* (液晶与显示), 2012, 27(5):658-665 (in Chinese).