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Design of a high-efficiency narrow spot headlamp with distributed LEDs

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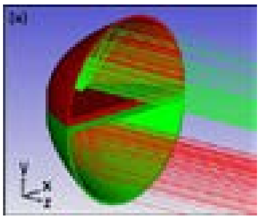
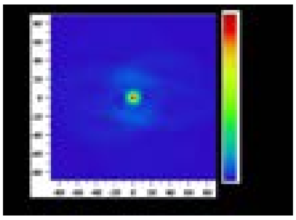
In this talk, we present a narrow spot headlamp system of the dual half circular parabolic aluminized reflector (PAR). This system has a property that each of the half-circular PAR contains five high-efficiency and small package light emitting diode (LED) chips with 180° rotational symmetry. Concerning traffic safety, the design criterion of train headlamp is to meet the code of Federal Regulations (CFR). In terms of the forecast of illuminated position on a screen, analytic derivation has been developed to study the optical path of a ray which is perpendicular to and emitted from the center of the LED chip. This ray stands for the main emitted ray of the LED chip and it is inside of the illuminated spot by the LED source on the screen. Therefore, we can analyze design systematically for determining where the LED chips ought to be placed in the PAR reflector for minimizing electricity consumption while satisfying the reliability constraints on train headlamp to ensure traffic safety. Compared to a typical train headlamp system with incandescent or halogen lamp needing several hundred watts, the proposed system only uses 20.18W to achieve the luminous intensity requirements. Compared with the typical train headlamp system incorporating incandescent or halogen lamp with a power rating about 200 to 350W, the proposed system only uses 20.18W to achieve the luminous intensity requirements. If the train headlamp turns on 8 hours a day, one year can save electricity about 584kW+h (=0.2kW+8h/d+365d). If electric power is generated from crude oil, according to the estimation of 0.26kg CO_2/kW.h in the literature, the proposed approach can effectively lower down about 152kg CO_2 emission per year for a single lamp.





Biography

Guo-Dung J Su had his BS degree from National Taiwan University in 1994. He then joined the University of California, Los Angeles and received and his MS and PhD in electrical engineering in 1998 and 2001 respectively. His Doctoral research interest is related to MEMS scanners with a flat mirror surface for active optical alignment and micromirror arrays for adaptive optics applications. Since 2004, he became an Assistant Professor at Graduate Institute of Photonics and Optoelectronics and Department of Electrical Engineering of National Taiwan University. His current researches include Optical system design, MEMS devices for optical communications, compact optical imaging systems and surface plasmon phenomenon on nanoparticles.

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