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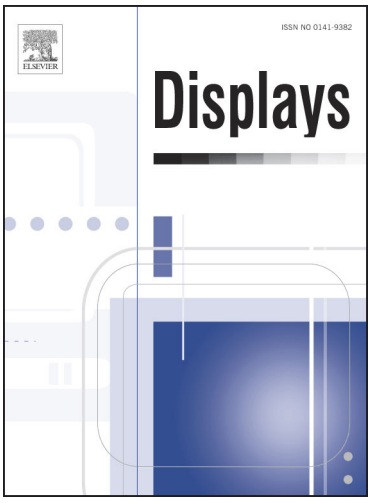

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Lighting for Road Tunnels: The Influence of CCT of Light Sources on Reaction Time

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Abstract

Drivers' visual performance is closely related to traffic safety in a real driving environment. In order to improve the traffic safety of road tunnel lighting, the effect of LED lighting on human visual performance was investigated using reaction time as a parameter. The experiment was performed with a scale model that can simulate a road tunnel lighting environment. Reaction times were measured under different values of luminance, correlated colour temperature (CCT), eccentricity, and contrast. The results show that visual performance can be improved by increasing the CCT of the light sources. The improvement of visual performance is greater in peripheral vision than that in foveal vision. The shortest reaction times were measured at a luminance level of 10 cd/m^2 and at a CCT of 5000 K. An appropriate luminance value with high CCT is recommended for tunnel lighting in interior and transition zones.

Keywords: tunnel lighting, traffic safety, visual performance, reaction time, CCT.

1 Introduction

A tunnel is a tubular semi-enclosed traffic area. Tunnel lighting regulations are complex, with different lighting level requirements for different zones (Commission International de l'Eclairage, 2004). Indeed, these lighting regulations have different effects on drivers' visual performance, and this can induce traffic accidents. Once a traffic accident occurs, the consequences are extremely serious. For example, on March 1, 2014, a traffic accident in the Shanxi Yanhou tunnel in China caused the death of 40 people and injured 12 others. The direct economic loss amounted to US $12 million (State Administration of Work Safety of China, 2014). Another recent traffic accident in the