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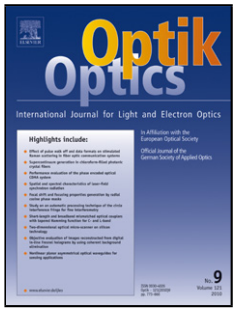

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3D Laser Imaging Using New Photometric Gaussian Range Equation and Phong Model Reflection

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ABSTRACT

This article tackles the challenging problem in creating 3D photorealistic scenes from mobile laser imaging data. The major disadvantage of this method is both its range and quality of reconstructed images. These parameters are strongly dependent among other on target materiel, size of the laser footprint and atmospheric attenuation. However, in this paper, we propose a new reformulation of the photometric Gaussian beam range equation on the basis of the Phong model reflection. The substantial contribution of this model in improving the quality of back return signals diffused from targets is confirmed. We prove that the novel model brings a capital gain in terms of the quality and maximum range of detection. This will increase significantly the resolution of reconstructed images and the accuracy of range measurement. Thus, the proposed approach appears promising for 3D active sensing for mapping and scenes modeling.

Keywords:

Laser ranging and imaging; Photometric range equation; Gaussian beam; Phong reflection model.

1. Introduction

The mobile laser imaging is one of the most interesting applications of light detection and ranging technique (LiDAR). This method uses 3D points cloud in order to generate 3D photorealistic urban models [1].

The active detection module of the system is based on a laser range finder for measuring the distance of targets with a high spatial resolution [2], [3]. As reported in [4], [5], the mathematical expression of the relationship between the detected power and the measured distance is known as radiometric range equation.

The improvement brought by M.Boujenab and N.E.Cherkaoui [6] describes the proposition of a new reformulation of the radiometric Gaussian range function. The proposed model takes into account the photometric parameters influencing the active detection. The purpose is to define the spatial sensor performance and especially accurately to specify the maximum distance where the laser system can be situated for always having a correct quality of the reconstructed images. In theory, this model seems to be appropriate for an active sensing (mobile device), without prior hypothesis about the nature of the targets (totally or partially reflecting). Although there are a lot of parameters that impact the fraction of the returned laser light. We can mainly mention the targets material, incidence angle and the influence of not modeled effects like atmospheric attenuation. In order to overcome this problem, the Phong model, used in computer 3D graphics, was reported and adapted by K. Kowalczyk and J. Rapinski [7], [8]. The use of this model was well verified for maximum range and intensity parameter modeling. Indeed, the incidence angle, material

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