

Title:	Parametric Anisotropic BRDF for 3D Reconstruction and Micro-Texture Evaluation
Author(s):	Kumar, Hitendra
Supervisor(s):	Ramkumar, J Venkatesh, K S
Keyword(s):	BRDF Reconstruction Surface Texture 3D Shape Shading
Subject(s):	Manufacturing Image Processing

Abstract: Over the years, several sophisticated finishing processes have been devised, however, with increasing complexity of parts, the need for precise characterization has arisen as well. The surface texture plays a critical role in determining functionality and quality of the manufactured part and the requirement becomes even more critical due to features being in micro and submicro scale. Hence, evaluation of surface texture is indispensable and still remains a challenge. In this research, a method for surface texture evaluation using machine vision is developed by studying the phenomenon of reflection from a real surface. A parameterized anisotropic bidirectional reflectance distribution function (BRDF) is proposed along with a fusion reconstruction method analogous to human visual system. Reconstruction of machined surface using the proposed reflection model is performed from image dataset. Machined surfaces obtained by performing mechanical grinding at varying machining conditions are analyzed using GLCM, wavelet decomposition, photometric stereo and fusion reconstruction based texture analysis to study and benchmark performance of both statistical and topographical surface texture evaluation methods. The four methods are implemented in MATLAB to estimate surface roughness parameters – Ra, Rq and Rz. Error analysis is performed by comparing estimated roughness values against stylus profilometer. Comparison reveals that fusion reconstruction estimates surface roughness closer to physical measurements as compared to GLCM, wavelet decomposition and photometric stereo based texture analysis.

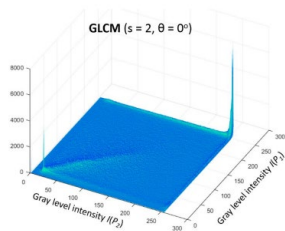


Figure 4.4. Fabricated collimated light source.

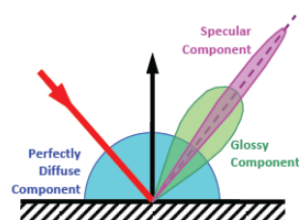
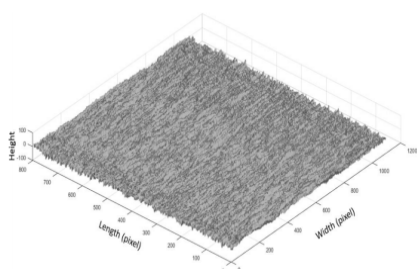
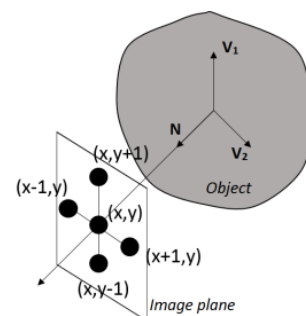


Figure 3.1. 3-Component BRDF. (Reflection models, Virial International)

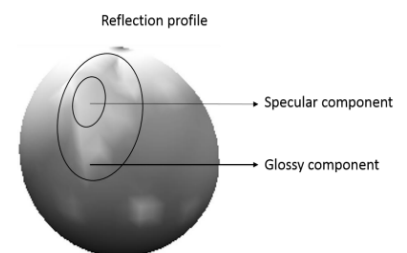


Figure 3.10. Components in generated BRDF profile