

**Modeling the Polarized Reflectance of Leaf***Donghui Xie<sup>1</sup>, Peijuan Wang<sup>2</sup> and Qijiang Zhu<sup>1</sup>*

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**Abstract:**

Plant leaves are the main organs for photosynthesis, which can affect the growing process, and the optical characteristics of leaves are the most primary factors effecting the distribution of directional reflectance of canopy. Therefore it is the foundation of reflectance from canopy to research the scattering character of a single leaf qualitatively and quantitatively.

In this paper, the polarized bidirectional reflectance factor (BRF) from several leaf surfaces were measured by a goniometer developed by Changchun Institute of optics, fine mechanics and physics, Chinese academy of sciences, including tender corn leaf, mature corn leaf, and lilac leaf.

The degree of polarization was calculated based on those measured polarized BRF data correspondingly. Some common characteristics of them can be obtained. Firstly, whole of the degrees of polarization increased with the increasing of incident zenith angle. Secondly, fixing the incident zenith angle, the degrees of polarization also raised with the increasing of view zenith angle basically. In other words, the degree of polarization was concerned with the incident and view directions tightly. However the leaves chosen here cannot represent all cases of leaves. Therefore the rules obtained here were restricted by only these samples measured. Later, other leaves sample will also be included to measure and analyze quantitatively.

Cook-Torrance bidirectional reflectance distribution function (BRDF) model was modified to simulate the polarized reflectance of leaf. And three parameters in this new model, such as diffuse reflectivity, refractive index and roughness of leaf surface, can be determined by inversing with the measured polarized BRF data.

According to the modified Cook-Torrance BRDF model, the several factors affecting the degree of polarization of leaf were analyzed quantitatively, such as incident and view directions, refractive index and roughness. Firstly, we found that the degree of polarization increased with incident zenith angle firstly but the relationship between the degree of

polarization and incident zenith angle was non-linear. Specially, when incident zenith angle reached the Brewster angle of leaf, the degree of polarization raise the greatest then decreased with incident zenith angle. Secondly, the degree of polarization increased with the increasing of refractive index and decreased with the increasing of roughness.

Commonly, it was very complex for the relationship between the degree of polarization and the parameters. Whatever the polarized BRDF model was useful for analyzing the polarized characteristics of leaf, even for canopy later quantitatively.

**Keywords:** BRDF, the degree of polarization, leaf

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