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Online Modeling for Future Fashion Factory Based on 3D Multispectral Colour Imaging and Data Fusion

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An increasing demand for 3D appearance modeling that demonstrates natural objects including fashion apparel vividly have been emerged with the arrived era featuring e-commence such as personalized design systems [1,2] and recommendation systems [3]. In recent years, 3D modeling for textile has been intensively investigated. However, it was mostly concentrated on mechanical properties of textile [4] in terms of compressive response [5], shear damage [6], drape [7] based on Kinematic [8] and multiscale 3D geometric [9-11] modeling. Other realistic properties modeling such as heat transfer [12] on textile 3D modeling has also been seen investigated, but the optical spectral property has not been seen significant progress in 3D display environment. The reason may be that the colour rendering [13-15] for 3D objects in computer industry has been standardized by BSDF (Bidirectional Spectral Distribution Function),however, it is complicated in that its number of modeling parameters attains to 16 for describing the spectral property of material [16] in 3D scene. Although it can be simplified to specific reflectance models corresponding to specific materials in practice such as "the default-shading model for OpenGL and Direct3D until recent times" [17], the 3D graphic of garments is much false rendered in contrasting to realistic ones as we can see from related literatures. Therefore, the methods of appearance acquisition and representation of 3D garments should be investigated dedicatedly. The challenges of appearance acquisition and representation, to be specific, 3D colour measurements and rendering [18,19], exist in that the acquisition and modeling of the spectral of material [20].

If the reflectance of every point of garments are acquired and stored, it could be virtually displayed or represented electronically with varying illuminants. Multispectral imaging can be introduced for the efficient acquisition for the spectral contents of the colour appearance of the 3D natural object, such as the garments on human bodies in indoor or outdoor lighting environments. Multispectral imaging has been a branch of colour science since 1990s, which has many mature methods for the integration of 3D and multispectral data for cultural heritage applications [21]. Especially, it should be note that the potential of the concept of broadband multispectral imaging [22-24], by which we can acquire high dimensional spectra by using just a few spectral acquisition channels. A logical 3D spectral imaging system for garments colour acquisition should be the integration of multispectral camera and 3D scanning instruments. Several such integrations used for cultural heritage applications [21] can be borrowed as a consequence, to reconstruct 3D colour by the response of RGB camera would really be an innovate method for multispectral garments imaging. A solid example may be reconstructing the spectral of human skin successfully from the response of RGB digital camera under controlled imaging parameters [24].

Moreover, it is possible to capture spectral contents of garments by RGB response of camera cluster of mobile phones, which maybe the instant RGB pictures pasted to Facebook, Tweeter and so on from the internet. In principle, if the SPD (spectral distribution) of illuminants or daylight [25] and the sensitivity of camera [26] can be estimated from the time and the geographic location of images taken, the camera model can calculate the spectral reflectance. Although there has been no perfect algorithm yet to estimate the daylight of imaging scene and the spectral sensitivity, the positive tendency could be expected. From the review of the state of art 3D colour modeling for online appearance of fashion apparel above and my professional background, innovate improvements could be contributed to the colour community and garment engineering through subsequent endeavors. As an expectation, the intended targets of following research and academic plan could be briefed as following:

i. To investigate colour measurement methods for 3D objects. With the developments of 3D graphics and virtue reality, it may be an international recognized pressing problem in the colour community. By far CIE has not been standardized it yet.

ii. To acquire the spectral contents of natural objects, especially of garments, under controlled or uncontrolled illuminants, even from internet connected environments by techniques from multispectral imaging and 3D shape modeling.

iii. To demonstrate 3D natural objects/garments in arbitrary illuminants or natural scene on electronic mediums by combining the techniques from 3D graphic and machine vision systems such as OpenGL and Open CV.

iv. To integrate data from other related aspects for the setup of useable and flexible functional modules satisfying for personalized design and retail recommendation in a human-in-loop e-commence ecology.

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