

Complex Monte Carlo ray tracing for optical characteristics analysis of human skin

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Abstract— To analyze and predict the concentration change of glucose in human skin, we developed a complex Monte Carlo ray tracing simulation tool. In this presentation, we will introduce the method of simulating the glucose concentration change at a particular depth and analyzing optical field distribution in the skin substrate using the developed complex Monte Carlo ray tracing.

I. Introduction

The optical simulation tool to analyze the optical reflection and transmission characteristics of human skin has been actively researched. It is commonly based on Monte Carlo method [1, 2] that can numerically predict various migration effects of photons in human skin or tissue. But, to find an effective method for investigating specific underneath skin data (for example, glucose concentration at that depth), we need to intensively simulate photon migration. For this, we developed complex Monte Carlo ray tracing simulation tool. In this presentation, we propose the method of obtaining skin information at a particular depth and analyze the operation of the proposed technique.

II. Result and Discussion

The schematic of optical sensing is depicted in Fig. 1 which is composed of a Talbot grating, coded aperture, and spectrophotometer. When an incident light illuminates the skin, some rays are not scattered and propagate to the target depth through the skin with very low probabilities. These non-scattered rays contain information of certain depth of skin. To catch the non-scattered reflected rays at the target position, we need to implement Fourier filtering with coded aperture. Total reflected rays are gathered on the focus, while scattered rays are not gathered on the focus in the Fourier plane [Fig.1]. To obtain underneath skin properties from filtered rays, we use several optical analyzing the Talbot grating zone method [3], using spectrophotometer and reconstructing skin image method.

In this presentation, we analyze the sensing system with numerical ray-wave hybrid optic model. Convention Monte Carlo method just calculates incoherent intensity distribution. However, we use complex Monte Carlo ray tracing method for wave optic modeling and analysis. We will discuss about modeling and simulation method, and numerical analysis about the method of sensing skin properties.

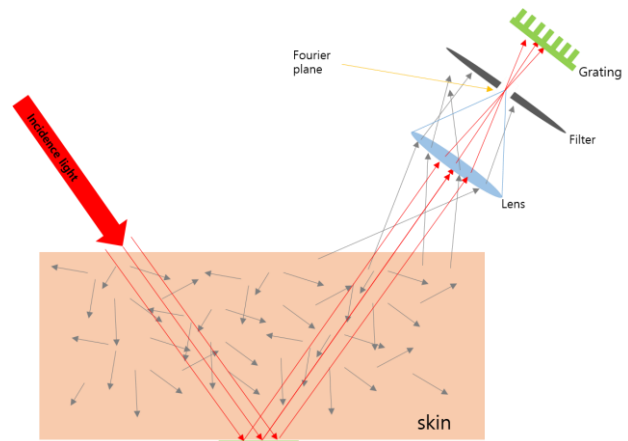


Fig.1 Schematic of selecting total reflected rays method

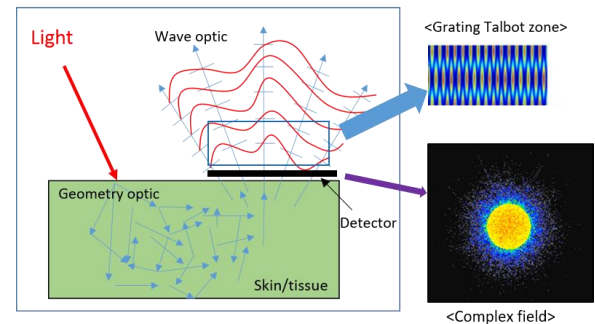


Fig.2 Schematic of complex Monte Carlo ray tracing method and analyzing method by using grating Talbot zone.

References

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