



Optoelectronics and Semiconductor Group

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Field of study: Diffraction, Applied Photonics Systems Design

Keyword : diffraction, simulation

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A. The Subject and Aims of Research

Primary research areas on applied photonics systems design, focused on using computer simulation software to design product prototypes. Innovative and intellectual property are closely related. Therefore search, analyze patents for applied photonics systems are crucial to my research as well. Besides, photonics systems in general based upon geometrical theory, although wave optics are few utilized, even fewer applications based on quantum optics. While my theoretical study on optics is based upon “system” approach, study and analyze system responses to various forms of optical signals. My objective to build a comprehensive of optical signal processing platform, which is suitable to adopt all geometrical, wave and quantum optics models. The result can be used in future novel photonics applications.

B. Related Recent Research Topics

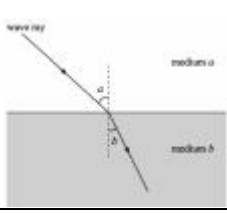
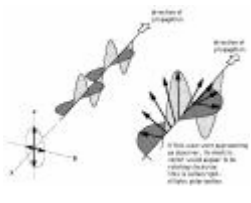
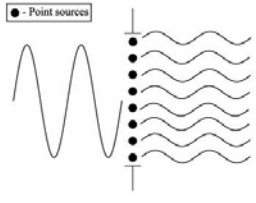
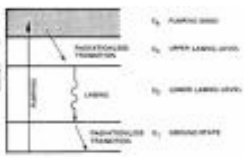
1. Quantum optics simulation engine

Nowadays simulation design technology has become a key step toward innovative product design in high technology industry. Through software simulation design technology, time and cost can be reduced considerably, thus become a strong competing factor in the market place. In general, optical simulation is conducted on expensive optical engine, and in general, these engines can not be used to simulate optical quanta behavior. It is our research interested to study how to build a quantum optics simulation engine, which is capable of doing quantum optics simulation, and applied on photonics systems design.

2. Optical signal processing mathematical model

In writing optical simulation engine, we based on system theory, to define module function, in terms of different input/output relationships :

Interaction	Icon	Input Optical Signal	System Function	Output Optical Signal
Reflection		$e^{(j\vec{k}_a \cdot \vec{r})}$	$e^{(j\vec{k}_a \cdot \vec{r})} * h_{a \rightarrow (-a)}(x, y)$ Impulse response	$e^{(j\vec{k}_{(-a)} \cdot \vec{r})}$

Refraction		$e^{(j\vec{k}_a \cdot \vec{r})}$	$e^{(j\vec{k}_a \cdot \vec{r})} * h_{a \rightarrow b}(x, y)$ Impulse response	$e^{(j\vec{k}_b \cdot \vec{r})}$
Polarization		$e^{i\pi/4} \begin{bmatrix} 1 & 0 \\ 0 & -i \end{bmatrix}$ Half-wave plate fast axis 垂直	$K \begin{bmatrix} 1 & 0 \\ 0 & -i \end{bmatrix}^{-1}$ • $\begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix}$	$\frac{1}{2} \begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix}$ Linear polarization At -450
Interference		$E_0 e^{i\omega t}$ Multiple beams interference	$\begin{bmatrix} r(1 - e^{-i\delta}) \\ 1 - r^2 e^{-i\delta} \end{bmatrix}$	\tilde{E}_r Multiple beams interference
Lasing		$\frac{2\pi\hbar c^2}{\lambda^5}$ • $\begin{bmatrix} 1 \\ \frac{hc}{e^{\lambda k_B T}} - 1 \end{bmatrix}$	via $d\lambda = -cd\nu / \nu^2$	$\frac{2\pi\hbar\nu^3}{c^2}$ • $\begin{bmatrix} 1 \\ \frac{h\nu}{e^{\lambda k_B T}} - 1 \end{bmatrix}$

C. Selected Publications and Projects

1. Paper : "Multimode Interference All-Optical Logic Gates via Partially Nonlinear Propagation Region, "OPTICAL REVIEW Vol. 10, No.5 (2003), pp.346-351.
2. Projects :
 - (1) NSC Open Source project – Design of optical engine via discrete event simulation technology (2004)
 - (2) MOE project – To build patent database of optical imaging systems via simulation technique (2005)