摘要：

基于物理的大气现象真实感模拟一直是计算机图形学研究的热点和难点之一。

它在计算机动画、电脑游戏、影视特技、文化宗教、军事仿真、建筑景观设计、休

闲旅游、虚拟现实等领域都有非常广泛的应用。本文主要研究两种特定的大气现象,

即“峨眉宝光”和航天器返回大气层过程中呈现的奇特现象。

本文第一章介绍了大气现象真实感模拟的意义及发展历程并对各种大气现象

进行了分类,并介绍了各类具体的大气现象如云、彩虹、日晕、极光、闪电等的建

模及绘制技术简述了本文的主要研究内容。

“峨眉宝光”是一种奇异的自然现象,在历史上对我国的宗教文化有过很大的

影响。本文第二章提出了对“峨眉宝光”真实感建模与绘制的新方法。算法首先基

于后向散射理论,计算得到宝光环的光谱分布对于宝光现象中的摄身光影,

提出了一个新的阴影模型来确定其变形后的形状及其模糊效果并考虑了太阳高度

角、雾中和云中水滴的大小及分布等因素,精确计算得到了宝光环的形状及颜色

最后,采用了路径散射的方法来对不同的宝光场景进行整体绘制。

航天器的发射和返回是目前关注的热点。本文第三章对航天器返回大气层的过

程进行了建模和绘制。首先,根据弹道方程求解出航天器返回大气层时的再入轨道

然后利用量子光学原理确定航天器舱体的温度场分布再采用等离子体辐射原理计

算出尾迹的形状并确定出其在不同时刻的颜色最后逼真地绘制出航天器返回穿越

大气时不同时刻所产生特异的尾迹形状和发光的变化效果。

Abstract:

Physically based simulation of atmospheric phenomena has been a hotspot and one

of the most difficult tasks in Compute Graphics. It has been found wide application in

many domains such as computer animation, computer games, special effects of movie,

culture, religion, battlefield simulation, landscaping, architecture, virtual reality, etc. We

will study the simulation of two particular atmospheric phenomena, Emei Glory and the

process of spacecraft's reentry through the aerosphere respectively.

In Chapter One, we introduce the significance and development of the simulation of

atmospheric phenomena and classify various kinds of atmospheric phenomena. Then we

present different kinds of modeling and rendering techniques for those atmospheric

phenomena such as the medeling and rendering of cloud, rainbow, halo, aurora, lighting

and so on. The main research works of this paper are present at last.

Emei Glory is a peculiar phenomenon, which has a significant impact on Chinese

culture and religion. In Chapter Two a novel method of photorealistic simulation of

Buddha Glory is proposed. To simulate the glory, we first calculate the spectral scatter

intensity of glory rings using Mie scattering theory. We then present a new shadow model

to determine the deformed shape of the head and body of "Buddha" within the glory ring.

For rendering, we adapt the method of path scattering integral to generate the whole

attenuated scene of Buddha Glory.

In Chapter Three, we introduce the modeling and rendering of the reentry process of

the spacecraft, based on the principle of Quantity Optics and Radiance of plasma. Finally,

realistic images of the spacecraft with fantastic wake shape and color during its reentry

through the aerosphere are drawn.

At the end of the dissertation, the author sums up all research in this paper, and give

the direction of following research.