

CZECH TECHNICAL UNIVERSITY IN PRAGUE  
FACULTY OF ELECTRICAL ENGINEERING



Masterer Thesis

**Progressive Computation of Global  
Illumination**

Prague, 2012

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## Acknowledgements

I would like to thank to Hanka Pokorná, who has always supported me. And also to Ing. Jaroslav Sloup for supervision of this thesis.



## Declaration

I hereby declare that I have completed this thesis independently and that I have listed all the literature and publications used.

Prague, 10. 11. 2012 \_\_\_\_\_

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Signature



## Abstract

Rendering volumetric phenomenas such as smoke or fog has always been challenging and time consuming task. Recently few new progressive rendering techniques were discovered and this thesis aims to test them on various scenes containing participating media.

## Abstrakt

Rendering opticky aktivních prvků jako je kouř či mlha, bylo vždy velice obtížné a časově náročné. V nedávné době se objevily nové progresivní metody výpočtu a v této diplomové práci je chceme vyzkoušet na různých scénách obsahujících opticky aktivní prostředí.





Vložit zadání práce



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# Chapter 1

## Introduction

Problem definition. What is optically active environment and example images. What is challenging.

Why global illumination and why progressive methods



# Chapter 2

## Fundamentals of realistic image synthesis

### 2.1 Radiometry

1) what is radiometry - asi z Jarosze + wikipedia

2) quantities: In this chapter I will define basic radiometry quantities to build enough support knowledge for the next chapter. - z meho prehledu z rso flux: irradiance: radiance:

Relationships between named quantities. -prehled rso

### 2.2 Surface interaction

-advanced illum techniques

assumptions and symplificaitons

#### 2.2.1 BRDF

-pbrt

### 2.2.2 Rendering equation

-advanced illum techniques Theory behind rendering equation, integration of radiometry quantities. Both surface and solid angle definitions

## 2.3 Volume interaction

assumptions made of particles simplification using probability -advanced illum techniques  
-popsat absorpci a dalsi veci

### 2.3.1 Phase functions

-jak dochazi k rozptylu svetla -pouzit matlabaky obrazky heney-g funkce ruzne koeficienty

### 2.3.2 Rendering equation including participating media

hezke odvozeni je v -advanced illum techniques

What steps have to be taken to get rendering equation to the next level.

## 2.4 Volume and surface interaction

In order to properly simulate light transport in the scenes containing both surfaces and volumetrically active media.

Different light transport paths surface surface, surface media, media surface, media media.

### 2.4.1 Extended rendering equation

Put together all the integrals pokračovat v odvozeni z -advanced illum techniques

# Chapter 3

## Common solutions

In this chapter we will try to summarize the most common technics for solving the rendering equation in the presence of participating media.

### 3.1 Rasterization

Still most used in films and games - fast approximation. Particle rasterization + rendering slices of 3D volumes can solve only direct illumination.

### 3.2 Raytracing

#### 3.2.1 Unbiased methods

Plus and cons

#### 3.2.2 Biased methods

irradiance caching, Photon tracing, final gather ... Plus and cons



# Chapter 4

## Consistent progressive methods

what does it mean to be progressive

### 4.1 Stochastic progressive photon mapping

### 4.2 Beam mapping

Hybrid solution cpu gpu rasterization..

### 4.3 Virtual point lights

### 4.4 Virtual ray lights

### 4.5 Virtual beam lights





# Chapter 5

## Proposed solution

I have chosen these methods and why... How to do it scheme of the progressive raytracing renderer.

co tu ma byt pouzil jsem tuhle a tuhle metodu proc odkazat se na predchozi kapitolu a zminit zmeny ktere jsem provedl a proc.

Co jsem orezal co rozsiril.

A dojit k blokovemu schematu co budu muset imlementovat. Mozna zminit i PBRT.



## Chapter 6

# Implementation

I have decided to implement it using pbrt. what is pbrt what structures I will use, which I have to create.

V tehle kapitole muzu i ukazat ty veci z matlabu ze funguji a jak. Klidne popsat, i postup implemntace pres jednoduzsi az po slozitejsi metody.



# Chapter 7

## Results

Mely by tu byt tabulky a srovnani metod a ruzne parametry.



# Chapter 8

## Conclusion

this method was implemented and results are great

### 8.0.1 Future work





# Appendinx A

## Appendix

abbreviations + test scene images



# Appendinx B

## DVD Content

galerie obrazku test scen