2 Syllabus

2.1 09:00 — Opening statement and introduction to path tracing (30 min, Johannes Hanika)

This talk will introduce the course and state our motivation for our continued efforts on this topic. Johannes will give a bit of context about rendering in the movie production industry. This includes a short historical perspective on rendering algorithms and a summary of what makes movie rendering different from other fields. The particular requirements are used as a benchmark for existing rendering algorithms. In a short overview, the most important variants of path tracing are explained and it is discussed when they fail.

2.2 09:30 — A short History of Monte Carlo (30 min, Luca Fascione)

Luca's section is supplemented by a rigorous survey of mathematical approaches to numerical integration in our course notes. The talk itself will showcase the different methods by example, such as quadrature rules, the Monte Carlo method, quasi-Monte Carlo integration, and Hamiltonian Monte Carlo. It is our goal to enable the audience to gain an intuitive understanding of the advantages and drawbacks of certain mathematical frameworks. Formally, we approach this by analysing the error bounds of the method and the function class for which these hold. The rigorous underpinning of these intuitive examples should help researchers develop new powerful tools.

2.3 10:00 — Implementing path sampling techniques (30 min, Marc Droske)

This talk carries over some of the insights of the previous two talks to production practice. We have seen that no single existing algorithm is capable of fulfilling the production needs yet, and that there is a theoretical reason for this: rendering requires us to integrate a function space with extremely heterogeneous properties in different regions of the domain. This means that we need to mix and match many specialised sampling techniques together to be able to render a shot successfully. The one tool we have at hand to perform this is multiple importance sampling. Marc will outline a software architecture that can combine an arbitrary amount of sampling techniques and transparently manage the weights.

2.4 10:30 — Break (15 min)

2.5 10:45 — Finding good paths (30 min, Jorge Schwarzhaupt)

Jorge will showcase a few practical importance sampling techniques which are essential to movie production at Weta Digital. While the basic techniques are common to most studios employing path tracing, he will share some insights that are particular to the large scale complexity of scenes encountered in visual effects. This includes a look at how next event estimation is done in Manuka, with a sophisticated light hierarchy that has been refined over many years. Jorge will also talk about specific path sampling optimisations for motion blur and depth of field by reconnecting complete paths to different pixels. The implementation of such techniques is greatly simplified by the architecture Marc talked about in the slot before.

2.6 11:15 — Volumes (30 min, Christopher Kulla)

Modern production path tracing renderers must contend with volumetric effects in addition to surfaces. These are essential to represent a wide array of natural phenomena (fog, smoke, dust, snow, fire, etc...). This extra dimension in the light transport equation opens up its own unique set of challenges for efficient sampling of light paths. In this part of the course, we will review the main families of sampling techniques which are

used in production, discuss how to combine them effectively and explore remaining open problems. We will also discuss production specific requirements such as how to deal with overlapping volumes, large numbers of light sources, massive data-sets and motion blur.

2.7 11:45 — The Ins of Production Rendering at Animal Logic (30 min, Daniel Heckenberg)

As path tracing has become the dominant paradigm for production rendering, representation of scene data has changed. After the long dominance of the RenderMan Interface Specification (RISpec), newer scene descriptions achieve different tradeoffs for computation efficiency, workflow and interactivity, complexity management and expressivity. We'll discuss Animal Logic's progression from RenderMan RIB, to Glimpse's GSS and Pixar's Universal Scene Description.