Realistic Rendering in Architecture and Product Visualization

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ABSTRACT

In the recent years, VFX and computer animation witnessed a "path tracing revolution" [Keller et al. 2015] during which most of the rendering technology has converged on the use of physically-based Monte Carlo techniques. This transition sparked a renewed interest in the topic of physically-based rendering but the focus has been almost exclusively on the application of these method in the movie industry. In the meantime, a significant segment of the realistic rendering market – that focusing on architectural, automotive, and product visualization – has been relying on the physically-based rendering technology since the beginning of the millennium. Despite that, relatively little attention in the communication at SIGGRAPH has been so far paid to this market segment.

The goal of this course is to fill this gap. We present user expectations in the "archviz" and product visualization markets and discuss the technological and engineering choices that these expectations imply on the rendering engines used in these fields. We juxtapose this technology to rendering for motion pictures and point out the most significant differences. Specifically, we discuss the pros and cons of CPU and GPU rendering, simple (unidirectional) vs. more advanced (bidirectional) light transport simulation methods, different approaches to "lookdev" and material design, artist workflows, and the integration of the renderers into the image creation pipeline. We conclude by discussing some open technological issues along with the constraints that the research community should consider so that the the developed methods respect the needs and expectations of the target user group.

CCS CONCEPTS

• **Computing methodologies** → **Computer graphics**; *Rendering*; Ray tracing;

KEYWORDS

Realistic rendering, architectural and product visualization, path tracing

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1 TARGET AUDIENCE

The course aims at a wide audience including students, researchers, software developers, and enthusiasts in the area of realistic rendering. Technically oriented artists will also benefit from the course.

The course is generally kept at a high-level and does not go into unnecessary technical details. We assume some general knowledge of the technology used in physically-based realistic rendering, though a brief introduction to these topics will be given at the beginning of the course.

2 RELATED COURSES

The adoption of physically-based rendering in the movie industry has drawn much attention to the topic, which also translated into a number of presented SIGGRAPH courses. A recent full-day course [Fascione et al. 2017a,b] covers physically-based rendering *in the movie industry* in great detail. Prior to that, a course by Keller et al. [2015] documented the transition of the rendering technology in the movie industry to physically-based techniques, the beginnings of which were covered in the course by Křivánek et al. [2010]. Two more theoretical courses [Křivánek et al. 2013, 2014] discuss the theory behind advanced bidirectional light transport simulation techniques. While the focus in the above courses was on movie making (or possibly game development [Křivánek et al. 2010]), the purpose of the present course is to open up the discussion to a different application domain – that of architectural and product visualization – where physically-based rendering techniques have in fact longer history than in movie production.

3 COURSE CONTENT

The main purpose of the course is to present and discuss the various algorithmic, engineering, and UI/UX design choices that one faces when developing rendering technology aiming specifically at architectural and product visualization. To that end, the course brings together key people behind some of the most successful archviz/product design renderers, such as V-ray (Vladimir "Vlado" Koylazov), Corona Renderer (Ondřej Karlík and Jaroslav Křivánek), KeyShot (Henrik Wann Jensen) or Indigo Renderer (Thomas Ludwig), with the goal to compare the different priorities and aspects taken into account when designing the respective pieces of software.

The course starts with an introduction of the basic concepts behind physically-based rendering so as to calibrate the background

knowledge of the wide audience that the course is intended for. We briefly outline the inner workings of a typical Monte Carlo renderer, including some basic concepts such as unbiasedness, convergence, progressive rendering, surface reflectance/materials etc. We mention the main differences between unidirectional and bidirectional path tracing as well as the main ideas behind photon mapping and light caching methods.

The next contibution brings an architectural visualization artist's view on the creation of compelling visualizations and on the use of various technology in this process, with a specific focus on the rendering engine.

The following block of presentations describes the main design considerations behind V-ray, Corona Renderer, KeyShot, and Indigo Renderer. While these rendering engines have much in common, each of them has some elements that make it unique: V-ray is an established rendering solution that bridges both the visualization and film-making fields. Corona Renderer was one of the first renderers whose design was entirely centered around maximum ease-of-use and a fully interactive work-flow. KeyShot is unique by its focus on the product design/CAD market. And finally, Indigo Renderer is a rare example of a renderer that relies on bidirectional path tracing as its default light transport solver.

In the last part of the course, we discuss some open technological problems and outline possible research directions. We present some of the main aspects that make a rendering algorithm useful and usable in a practical rendering solution.

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