Ray Tracing: A Tool for All

Jon Peddie

Ray Tracing: A Tool for All

Springer

Jon Peddie
Jon Peddie Research
Belvedere Tiburon, CA, USA

ISBN 978-3-030-17489-7 ISBN 978-3-030-17490-3 (eBook)
https://doi.org/10.1007/978-3-030-17490-3

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Foreword I

Shaded rendering has been one of the central topics of computer graphics research since the 1960s. Over the following decades, researchers have developed rendering techniques that evolved step-by-step from smooth shading to realistic reflections and ultimately to a level of realism that allows us to ignore the fact that the rendered images are not real.

Back in the early 1980s, Jon Peddie and I met for breakfast one weekend morning to discuss ways to commercialize realistic rendering. At the time, the idea seemed far-fetched. Today, it has become commonplace and it has found applications we had not imagined.

Making use of realistic rendering, whether for Hollywood special effects, video games, or redecorating your living room still requires an understanding of what it is and how it works. Papers, journals, books, and courses dive into the topic and open up the world of rendering to the average programmer. But what if you are not a programmer? Today, most of us want to use the technology without programming it from scratch. Regardless, a sophisticated graphics system requires some understanding of the technology in order to get the most use from it. That's where Jon Peddie's text comes into play.

Somewhere between the ten thousand foot overview and the vast collection of GPU code hiding beneath the surface is a level of explanation and understanding that provides a prospective user with enough background to get started. This book covers that range in detail, but in a manner that can be understood without reviewing graduate-level mathematics. It does a particularly good job of identifying both hardware and software resources to enable a beginning practitioner to get up and running.

To me personally, the most compelling sections of the book are the ones that fall into the category labeled "I didn't know that!" The number of contributors and the diversity of approaches that have brought realistic rendering to its current state are remarkable. Rather than attempting to condense this all into a summary, Jon has opted for completeness and has given the reader a full view of the topic.

In essence, this book is a story. It explains the technology, the applications, and the products, while also providing a history. You, the reader, don't need to spend 40 years writing and reviewing technical papers on rendering and ray tracing. Just read the book.

Chapel Hill, North Carolina Turner Whitted

Foreword II

Ray tracing is a topic that has inspired many engineers, artists, and storytellers. For some, it is a computer graphics course; for others, it is a degree; and for many—an entire career.

I count myself as one of those people so inspired. One day strolling through the engineering library, I browsed through a book entitled simply "Introduction to Ray Tracing." It instantly captured my imagination. The images were strikingly beautiful (compared to the state of the art the time), the math was approachable, and it only took a few hours to produce a single image! I soon learned that I was not alone—that other students and researchers were exploring the frontiers "photorealism," or the idea that a computer-generated image could be indistinguishable from a photograph.

For me, this inspiration launched a career. I am now a Vice President at Nvidia where I lead a team of dedicated engineers who are striving to make ray tracing fast enough to be used in real-time computer graphics. The goal is to bring the techniques that have brought advancements in visual effects and animation to gaming and design. Many in the industry share that goal.

It was this role that introduced me to Jon Peddie and his vast sphere of influence. I quickly learned that he travels the world in pursuit of technology, especially computer graphics, and ray tracing in particular. He is always learning, asking questions, probing technology, and getting all sides of a story. Along with Kathleen Maher, Jon integrates this information into some of the most influential reports in the computer graphics industry, including TechWatch and the JPR Workstation report. In addition, Jon gives countless lectures, serves on advisory boards, and has been recognized by ACM and CAAD for his efforts.

That is why I was intrigued when he told me of his plan to write a book on ray tracing. Many technical books have covered this topic in great depth, and Jon mentions many of them herein. However, "Ray Tracing: A Tool for All" brings an entirely fresh perspective to the topic. While he covers the technology and business in great depth, it is approachable by technical and non-technical readers alike.

Ray tracing has roots in medieval times, but received first attention for computer graphics via a paper by Turner Whitted at SIGGRAPH 1979. Ray tracing operates by simulating the physics of light as particles that interact with various surfaces, using very few simplifying assumptions. Because the human visual system is highly attuned to lighting in the physical world, subtle details can make the difference between an object looking "realistic" and "fake." Ray tracing can capture these effects, such as global illumination, soft shadows and accurate materials. Consequently, ray tracing is nearly ubiquitous in computer animation and visual effects industry. It is also rapidly becoming the standard in product design, marketing, and even real-time gaming.

A ray tracing program can be simple enough to fit on a business card, but turning it into a fully functional system (or renderer) results in very large sophisticated software. The results can be undeniably beautiful, and this book highlights many of these examples.

What Jon has done is take all of this technical excitement—the passions of inventors, the curiosity of a student or researcher, the creativity of the artists—and mapped it to the ecosystem and companies in the modern world. He covers the businesses around ray tracing, the interplay between the technology and the companies, and he speculates on what the future will bring to the industry. True to Jon's reputation, the book is filled with facts, data, and unique insight. It discusses the history, the workflows, the research papers, the hardware, the start-ups, and the primary technical challenges being tackled in the industry today.

Behind the technology and businesses, the primary goal of computer graphics is to use a visual I illusion to tell a story. Whether used for entertainment, a product introduction, or to gain insight—ray tracing has found application in a broad set of industries. Jon outlines these applications and ecosystems in a clear manner.

I learned a lot from reading "Ray Tracing: A Tool for All." It collects the under-documented aspects of computer graphics and paints a portrait that blends both technology and business. I expect that it will help inspire even more people to join in the quest of photorealistic rendering.

Dr. Steven G. Parker
Vice President
Professional Graphics, Nvidia
Chapel Hill, North Carolina

Acknowledgements

How could anyone write a book like this without having too many friends? I've met so many people over the years, starting with Turner Whited in 1979, who have made incredible discoveries and inventions. And then, demonstrating their extraordinary grace and charity, they took the time to edit (and mostly correct) the material I sent to them—I am truly blessed.

I know I'm missing someone or two in this list, and to you, should you read this, I am truly sorry—call me, I'll make amends.

My benefactors and mentors—the folks who really know what ray tracing is about, this book really would not exist without these people.

Helen Desmond, my patient and supportive editor at Springer
Alexander Keller, Nvidia—great comments and polite nudges
Alexandra Constantine, Autodesk
Ankit Patel, Nvidia
Brian Savery, AMD
Colin McLaughlin, Chaos—invaluable resource
Daniel Pohl, Intel—brilliant developer
David Harold, Imagination Technologies
David Laur, Pixar
David McGavran, Maxon
David Tracy, Chaos
Frederic Servant, Autodesk—a real pro
Glen Matthews, AMD
Henrik Edstrom, Autodesk
Igor Zanic, Houdini
Jama Jurabaev, Lucas Arts
John Hart, University Illinois
Joseph Taraborrelli, Sony
Josh Mings, Luxion
Katrina Felicano-Stoddard, Intel
Lon Grohs, Chaos

Ludwig von Reiche, Nvidia
Lynette Clee, Chaos
Oliver Meiseberg, Maxon
Phillip Miller, Chaos
Rolf Herken, ViewMagic
Sean Morrison, BRL-CAD
Steven Parker, Nvidia—who didn't sign up to be my editor and ended up reading every word
Tom Svilans, 3D modeler
Ton Roosendaal, Blender
Turner Whited, Nvidia (ret)—a big debt

My colleagues and collaborators

Kathleen Maher—encouraged me to see it through
Ruchike Saini
Jaydeep Bhattacharjee
Robert Dow
Peter McGuinness

Contents

List of Figures

List of Tables