

# REAL-TIME RENDERING

FOURTH EDITION

Thomas Auerhues • Thomas Haines • Nathan Fries • Michael Ivanicki • Sébastien Hillaire

Thoroughly updated, the fourth edition of *Real-Time Rendering* focuses on modern techniques used in games and film. This advanced primer is a treasure of a manual. It provides a guide to the most significant techniques developed and applied over the past decade, and includes case study case studies on 3D engines and physical-based materials and lighting, global illumination, and ray-traced shadows, rendering an opportunity to read. Some previous sections are now expanded into chapters on color, shadows, volumetric techniques, and advanced shading. A new chapter has been added about neural and deep learning. This edition focuses on games, practical rendering methods used in games and other applications. It also presents a solid foundation of fundamentals and the relevant mathematics for the field of interactive computer graphics, all in an approachable style.

## Review

"This is the book I recommend to everyone coming out of the industry. Not only is it a great reference on its own, but it's also a great primer to get you up to speed on important topics with great resources for further exploration!"

— Dan Madsen, *Unity*

"The *Real-Time Rendering* continues to evolve through its cutting-edge papers, GPGUs, and brings into a single source the most relevant rendering today's best practices, open problems, and promising state-of-the-art research. It is a treasure trove for researchers and engineers!"

— Dr. Christian Hopmann, *Principal Research Scientist, NVIDIA*

"Since it was first published, *Real-Time Rendering* has been an invaluable companion to anyone who wants to keep up with the industry field. It continues to provide coverage of the fundamentals with up-to-date details on the latest techniques. The fourth edition is a great reading for anyone serious about computer graphics!"

— Mark Hahn, *co-author of Physically Based Rendering: From Theory to Implementation*

"This book's rendering engine and its case studies that I learned in previous editions of *Real-Time Rendering*. The new edition is carefully updated to represent the current state of the field, and will remain the best resource I think when tackling a new challenge!"

— Frank Gatz, *Principal Graphics Engineer, Lead, and author of Unreal Engine 4*

"*Real-Time Rendering* is the best book I recommend reading to anyone who wants to learn about the graphics of the latest knowledge in the field, and a go-to book, too!"

— Steve Rabinovich, *Unity Technologies*

**Meet the Game:** The cover shows an example of advanced real-time rendering technology used in the 2018 film *Star Wars: The Last Jedi*, which includes real-time ray-traced shadows and area light shadows cast from the Stormtrooper. The film was produced by *Lucasfilm* and held an award for Best Visual Effects at the 91st Academy Awards.

Game and Animation



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Thomas Auerhues

Eric Haines

Nathan Fries

Angelo Pesce

Michael Ivanicki

Sébastien Hillaire



# Real Time Rendering Third Edition

**Julia Schneider**



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## **Table of Contents Real Time Rendering Third Edition**

1. Understanding the eBook Real Time Rendering Third Edition
  - The Rise of Digital Reading Real Time Rendering Third Edition
  - Advantages of eBooks Over Traditional Books
2. Identifying Real Time Rendering Third Edition
  - Exploring Different Genres
  - Considering Fiction vs. Non-Fiction
  - Determining Your Reading Goals
3. Choosing the Right eBook Platform
  - Popular eBook Platforms
  - Features to Look for in a Real Time Rendering Third Edition
  - User-Friendly Interface
4. Exploring eBook Recommendations from Real Time Rendering Third Edition
  - Personalized Recommendations
  - Real Time Rendering Third Edition User Reviews and Ratings
  - Real Time Rendering Third Edition and Bestseller Lists
5. Accessing Real Time Rendering Third Edition Free and Paid eBooks
  - Real Time Rendering Third Edition Public Domain eBooks
  - Real Time Rendering Third Edition eBook Subscription Services
  - Real Time Rendering Third Edition Budget-Friendly Options

- 
6. Navigating Real Time Rendering Third Edition eBook Formats
    - ePub, PDF, MOBI, and More
    - Real Time Rendering Third Edition Compatibility with Devices
    - Real Time Rendering Third Edition Enhanced eBook Features
  7. Enhancing Your Reading Experience
    - Adjustable Fonts and Text Sizes of Real Time Rendering Third Edition
    - Highlighting and Note-Taking Real Time Rendering Third Edition
    - Interactive Elements Real Time Rendering Third Edition
  8. Staying Engaged with Real Time Rendering Third Edition
    - Joining Online Reading Communities
    - Participating in Virtual Book Clubs
    - Following Authors and Publishers Real Time Rendering Third Edition
  9. Balancing eBooks and Physical Books Real Time Rendering Third Edition
    - Benefits of a Digital Library
    - Creating a Diverse Reading Collection Real Time Rendering Third Edition
  10. Overcoming Reading Challenges
    - Dealing with Digital Eye Strain
    - Minimizing Distractions
    - Managing Screen Time
  11. Cultivating a Reading Routine Real Time Rendering Third Edition
    - Setting Reading Goals Real Time Rendering Third Edition
    - Carving Out Dedicated Reading Time
  12. Sourcing Reliable Information of Real Time Rendering Third Edition
    - Fact-Checking eBook Content of Real Time Rendering Third Edition
    - Distinguishing Credible Sources
  13. Promoting Lifelong Learning
    - Utilizing eBooks for Skill Development
    - Exploring Educational eBooks
  14. Embracing eBook Trends
    - Integration of Multimedia Elements

- 
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