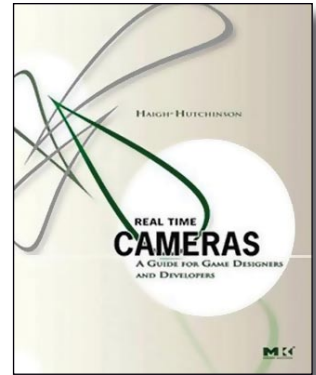




# REAL TIME CAMERAS

## A Guide for Game Designers and Developers By Mark Haigh-Hutchinson

REVIEWED BY BIJAN FORUTANPOUR



**A FEW YEARS AGO I HAD THE TASK OF** writing a camera system for a game. The design spec was simple: Look at two given games for reference, and implement something similar, an approximate hybrid of the two. Having never written a camera system before, it was an interesting and challenging task. The camera behaved differently in different situations, so it quickly became obvious that the problem had to be broken down into smaller pieces and categories. Along the way, many things went wrong and many things right, and that is when I developed an appreciation for the art and science of camera programming. When the opportunity arose to write a review for *Real-Time Cameras, A Guide For Game Designers and Developers* I jumped, because this book wasn't around when I needed it. Furthermore, I wanted to see whether what I had figured out on my own was close to the "correct" solution(s) proposed by the book.

The secret sauce to creating a good camera system is to realize that if it is done well, no one will notice. Conversely, if the design or implementation is poor, everyone will notice. A game camera needs to feel natural without jarring the player out of the world they are immersed in. This is not an easy task, and one where *Real-Time Cameras* leads the way. The book is organized into three parts, Core Concepts, Design Principles, and Camera Engineering.

### CORE CONCEPTS

» The Core Concepts section lays a basic foundation for the reader, covering a typical game update

loop where input is received from the controller, game objects are updated, and messaging and events are processed. Finally the camera is updated, and the final render performed. Basic camera fundamentals, behaviors, and terminology are then covered in the following chapter, followed by a quick lesson in cinematography. The Core Concepts section of the book is a good starting point for beginners new to game development and camera design. For experienced programmers unfamiliar with filmmaking concepts, it is also worth a quick read to help communicate with the artists and designers on the team.

### DESIGN PRINCIPLES

» This section of the book is oriented toward game camera designers and the information presented in these chapters is focused on theory and concepts. Because game development teams will have different game engines as well as different art and design production pipelines the book takes a general approach. It covers the different types of scrolling 2D camera behaviors such as continuous, character-relative, screen-relative, and directional lag, among others. Then 3D cameras are discussed, covering different types of projections, followed by a good list of dos and don'ts when designing camera systems.

The next chapter goes through an exhaustive list of game genres and the types of cameras appropriate for each genre. The section on camera design is concluded with a chapter on camera scripting as a method for describing camera behaviors. The

topics of script objects and object relationships are covered, as well as camera hints, pathing, trigger volumes, and script debugging.

### CAMERA ENGINEERING

» Camera Engineering is the real strength of the book, and the largest section. Different problems and requirements are presented, along with proposed solutions. It begins by covering different methods for computing desired camera position and orientations. The list of behavior types is complete; stationary cameras, slaved cameras, path constrained, surface and volume constrained, framing, object-framing relative, and axis rotational cameras are all explained. Camera orientation methods are also exhaustively presented: constant,

object tracking, look-at offset, locked, object position prediction, object framing, idle wandering, and automated orientation controls.

The next two chapters continue the discussion and present the more difficult challenges, covering the topics of navigation, occlusion, motion, and collision. The lesson to take away from these chapters is that there are many ways to solve a given problem. The more simple and successful solutions involve using spline-based pathing as a way to guide the camera through difficult terrain situations. Path splines may be built a priori by the game designers, or they may built by the camera system on the fly, perhaps using preexisting hints, objects, and volumes, among others. The best way to solve a tricky problem is to avoid it. The alternative is to simplify the problem and always have a fail-safe escape plan when the worst-case scenario actually occurs. Typically, this would be doing a jump cut of the camera to a new location, or simply making problem objects transparent or semitransparent. There is much more advice and trickery up the author's sleeve, which makes these chapters very valuable.

Next comes a chapter on the mathematics used in the algorithms presented, focusing mostly on different spline types commonly used in pathing. Different types of interpolation are discussed as well, although sometimes at a cursory level. For instance, quaternions are mentioned, though not described in detail.

The book concludes with a chapter on a proposed organization for a camera system, namely the

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 BY MARK HAIGH-HUTCHINSON

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different types of managers as they might be mapped into C++ classes.

## PROS AND CONS

» *Real-Time Cameras* offers a wealth of information and is very broad in scope. Its goal is to teach beginners theory and terminology, as well as give game designers some design guidelines and ideas for what is possible, while at the same time helping programmers with implementation details. While a very noble goal, this makes the book slightly frustrating to read cover to cover, because the same concepts are repeated multiple times, depending on the target audience. To use programming terminology, the book takes a breadth-first traversal of the material, making a first pass at individual subjects (e.g. camera POVs, navigation,

occlusion, etc.) in order to keep the discussion brief and in context, and then revisits each topic again a few chapters later to repeat as well as go into further detail. This approach has advantages and disadvantages.

The solution for the reader is to simply begin reading at the section of the book targeted toward their particular interests. As a programmer, I was looking for a depth-first approach to the material, a kind of *Game Camera Gems* that quickly cut to the details of algorithm and implementations. The best approach in this case would be to just begin reading at Chapter 7, where the Camera Engineering section of the book begins. Similarly, a game designer looking to fill his or her playbook with camera design strategies should focus on Chapters 4, 5, and 6.

*Real-Time Cameras* does have some brief code snippets interspersed throughout. There is a website that accompanies the book which was stated to contain the implementation of a simple camera system. Unfortunately, the Microsoft Visual Studio project files do not compile because they reference a significant amount of missing source code. The book also states that the website provides movie examples and analysis of camera design in existing games, but those do not appear on the website either. We hope the website will be completed in the near future, as it holds the promise of becoming a valuable resource for developers.

## IN FOCUS

» *Real-Time Cameras* contains a metric ton of real world experience

gathered through many years of dedicated work in game camera development by the author. It leaves no stone unturned, giving an exhaustive list of problems, solutions, and gotchas to watch out for in the solutions. As I mentioned at the beginning of this article, I was able to implement a real-time camera system for a game without any prior camera programming experience, but there was a lot of trial and error involved. Having this book as a guide would have helped save a lot of time, and is well worth the read.

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