

Physics for Game Programmers

GRANT PALMER

Apress®

Physics for Game Programmers

Copyright © 2005 by Grant Palmer

All rights reserved. No part of this work may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording, or by any information storage or retrieval system, without the prior written permission of the copyright owner and the publisher.

ISBN (pbk): 1-59059-472-X

Printed and bound in the United States of America 9 8 7 6 5 4 3 2 1

Trademarked names may appear in this book. Rather than use a trademark symbol with every occurrence of a trademarked name, we use the names only in an editorial fashion and to the benefit of the trademark owner, with no intention of infringement of the trademark.

Lead Editor: Tony Davis

Technical Reviewers: Alan McLeod, Jack Park

Editorial Board: Steve Anglin, Dan Appleman, Ewan Buckingham, Gary Cornell, Tony Davis, Jason Gilmore, Jonathan Hassell, Chris Mills, Dominic Shakeshaft, Jim Sumser

Assistant Publisher: Grace Wong

Project Manager: Laura E. Brown

Copy Manager: Nicole LeClerc

Copy Editor: Ami Knox

Production Manager: Kari Brooks-Copony

Production Editor: Kelly Winquist

Compositor: Susan Glinert

Proofreader: Liz Welch

Indexer: John Collin

Artist: Kinetic Publishing Services, LLC

Cover Designer: Kurt Krames

Manufacturing Manager: Tom Debolski

Distributed to the book trade in the United States by Springer-Verlag New York, Inc., 233 Spring Street, 6th Floor, New York, NY 10013, and outside the United States by Springer-Verlag GmbH & Co. KG, Tiergartenstr. 17, 69112 Heidelberg, Germany.

In the United States: phone 1-800-SPRINGER, fax 201-348-4505, e-mail orders@springer-ny.com, or visit <http://www.springer-ny.com>. Outside the United States: fax +49 6221 345229, e-mail orders@springer.de, or visit <http://www.springer.de>.

For information on translations, please contact Apress directly at 2560 Ninth Street, Suite 219, Berkeley, CA 94710. Phone 510-549-5930, fax 510-549-5939, e-mail info@apress.com, or visit <http://www.apress.com>.

The information in this book is distributed on an “as is” basis, without warranty. Although every precaution has been taken in the preparation of this work, neither the author(s) nor Apress shall have any liability to any person or entity with respect to any loss or damage caused or alleged to be caused directly or indirectly by the information contained in this work.

The source code for this book is available to readers at www.apress.com in the Downloads section.

Contents at a Glance

About the Author	xvii
About the Technical Reviewers	xix
Acknowledgments	xxi
Introduction	xxiii
CHAPTER 1 Adding Realism to Your Games	1
CHAPTER 2 Some Basic Concepts	5
CHAPTER 3 Basic Newtonian Mechanics	21
CHAPTER 4 Basic Kinematics	49
CHAPTER 5 Projectiles	83
CHAPTER 6 Collisions	139
CHAPTER 7 Sports Simulations	167
CHAPTER 8 Cars and Motorcycles	211
CHAPTER 9 Boats and Things That Float	245
CHAPTER 10 Airplanes	275
CHAPTER 11 Rockets and Missiles	319
CHAPTER 12 The Physics of Solids	351
CHAPTER 13 Explosions	371
CHAPTER 14 Lasers	385
CHAPTER 15 Probabilistic and Monte Carlo Simulations	403
■ INDEX	423