

Physics FOR GEARHEADS

An Introduction to Vehicle Dynamics, Energy, and Power
with Examples from Motorsports

Randy Beikmann, Ph.D.



Randy Beikmann holds a Ph.D. in mechanical engineering from the University of Michigan. He is a technical specialist in automotive noise and vibration at the General Motors Milford Proving Ground, where he has worked since 1983. He has published numerous papers on powertrain noise and vibration and has helped design and teach classes at GM within his engineering specialty. He currently holds three patents.

There is no better way to learn physics than by having a problem to solve.

As a gearhead, you have a secret advantage when it comes to understanding physics: you see it at work every time you solve a problem with your car or watch a motorsports event. The experience you already have tuning cars or motorcycles is your virtual physics lab. *Physics for Gearheads* will show you that if you can learn about cars, you can learn about physics.

Whether your interest is in increasing your engine's horsepower, getting more miles per gallon, or shaving tenths off your lap time on track day, you can use physics to gain insight into the problem and formulate a solution. *Physics for Gearheads* not only explains physics principles in language you can understand, it demonstrates how to use physics to your advantage.

Randy Beikmann is an automotive engineer working at the top of the industry. And he loves physics. Through his masterful teaching, physics doesn't look foreign—it looks like common sense.

Chapters

- 1 A Warm-Up Lap
- 2 Kinematics Basics
- 3 Kinematics Applications
- 4 Dynamics Basics
- 5 Forces
- 6 Dynamics Applications
- 7 Torque, Force Resolution, and 2-D Vectors
- 8 Angular Dynamics Basics
- 9 Angular Dynamics Applications
- 10 Dynamics in a Plane Basics
- 11 Dynamics in a Plane Applications
- 12 Energy Basics
- 13 Energy Applications
- 14 Power Basics
- 15 Power Applications
- 16 Statics and Quasi-Statics Basics
- 17 Statics and Quasi-Statics Applications



Finding mean piston speed in a typical NASCAR engine from its stroke (Chapter 3)



A Corvette converting kinetic energy to heat as it brakes hard for a turn (Chapter 12)



Calculating lateral acceleration in cornering (Chapter 10)

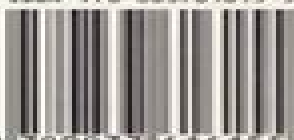


Immense tire forces creating the quick launch of a Mustang Funny Car (Chapter 4)



The lateral and vertical forces that develop as a bike corners hard (Chapter 16)

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Physics For Gearheads An Introduction To Vehicle Dynamics Energy And Power With Examples From Motorsports

James Balkwill



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Physics for Gearheads Randy Beikmann,2015-03-01 *Performance Vehicle Dynamics* James Balkwill,2017-08-24

Performance Vehicle Dynamics Engineering and Applications offers an accessible treatment of the complex material needed to achieve level seven learning outcomes in the field Users will gain a complete structured understanding that enables the preparation of useful models for characterization and optimization of performance using the same Automotive or Motorsport industry techniques and approaches As the approach to vehicle dynamics has changed over time largely due to advances in computing power the subject has in practice always been computer intensive but this use has changed with modeling of relatively complex vehicle dynamics topics now even possible on a PC Explains how to numerically and computationally model vehicle dynamics Features the use of cost functions with multi body models Learn how to produce mathematical models that offer excellent performance prediction **Kinetic Energy Recovery Systems for Racing Cars** Alberto Boretti,2013-04-02 A kinetic energy recover system KERS captures the kinetic energy that results when brakes are applied to a moving vehicle The recovered energy can be stored in a flywheel or battery and used later to help boost acceleration KERS helps transfer what was formerly wasted energy into useful energy In 2009 the Federation Internationale de l Automobile FIA began allowing KERS to be used in Formula One F1 competition Still considered experimental this technology is undergoing development in the racing world but has yet to become mainstream for production vehicles The Introduction of this book details the theory behind the KERS concept It describes how kinetic energy can be recovered and the mechanical and electric systems for storing it Flybrid systems are highlighted since they are the most popular KERS developed thus far The KERS of two racing vehicles are profiled the Dyson Lola LMP1 and Audi R18 e tron Quattro Four SAE technical papers follow the preface and focus on the use of KERS technology in F1 racing The first paper examines the factors that influence hybrid performance and enable optimization for different racing circuits The second paper describes a Flybrid KERS designed for the 2009 F1 season The third paper considers the development of an electric KERS for the 2009 F1 season The fourth paper presents the challenges and opportunities of the 2014 F1 engine and powertrain rules particularly as they pertain to KERS This book has been published for automotive engineers who are interested in hybrid systems energy recovery regenerative braking and improving acceleration It will also be useful for powertrain designers researchers academics and motorsports professionals race engineers team managers and technology practitioners who design and build racing powertrains

Vehicle Dynamics Martin Meywerk,2015-04-27 Comprehensively covers the fundamentals of vehicle dynamics with application to automotive mechatronics Presents a number of different design analysis and implementation considerations related to automobiles including power requirements converters performance fuel consumption and vehicle dynamic models Covers the dynamics modeling and control of not only the entire vehicle system but also of key elements of the vehicle such

as transmissions and hybrid systems integration Includes exercise problems and MATLAB codes Accompanied by a website hosting animations

Fast Car Physics Chuck Edmondson, 2011-03-01 Revving engines smoking tires and high speeds Car racing enthusiasts and race drivers alike know the thrill of competition the push to perform better and the agony and dangers of bad decisions But driving faster and better involves more than just high horsepower and tightly tuned engines Physicist and amateur racer Chuck Edmondson thoroughly discusses the physics underlying car racing and explains just what's going on during any race why and how a driver can improve control and ultimately win The world of motorsports is rich with excitement and competition and physics Edmondson applies common mathematical theories to real world racing situations to reveal the secrets behind successful fast driving He explains such key concepts as how to tune your car and why it matters how to calculate 0 to 60 mph times and quarter mile times and why they are important and where when why and how to use kinematics in road racing He wraps it up with insight into the impact and benefit of green technologies in racing In each case Edmondson's in depth explanations and worked equations link the physics principles to qualitative racing advice From selecting shifting points to load transfer in car control and beyond Fast Car Physics is the ideal source to consult before buckling up and cinching down the belts on your racing harness

Vehicle Dynamics, Stability, and Control, Second Edition Dean Karnopp, 2013-01-23 Anyone who has experience with a car bicycle motorcycle or train knows that the dynamic behavior of different types of vehicles and even different vehicles of the same class varies significantly For example stability or instability is one of the most intriguing and mysterious aspects of vehicle dynamics Why do some motorcycles sometimes exhibit a wobble of the front wheel when ridden no hands or a dangerous weaving motion at high speed Why does a trailer suddenly begin to oscillate over several traffic lanes just because its load distribution is different from the usual Other questions also arise How do humans control an inherently unstable vehicle such as a bicycle and how could a vehicle be designed or modified with an automatic control system to improve its dynamic properties Using mainly linear vehicle dynamic models as well as discussion of nonlinear limiting effects Vehicle Dynamics Stability and Control Second Edition answers these questions and more It illustrates the application of techniques from kinematics rigid body dynamics system dynamics automatic control stability theory and aerodynamics to the study of the dynamic behavior of a number of vehicle types In addition it presents specialized topics dealing specifically with vehicle dynamics such as the force generation by pneumatic tires railway wheels and wings The idea that vehicles can exhibit dangerous behavior for no obvious reason is in itself fascinating Particularly obvious in racing situations or in speed record attempts dynamic problems are also ubiquitous in everyday life and are often the cause of serious accidents Using relatively simple mathematical models the book offers a satisfying introduction to the dynamics stability and control of vehicles

Engineer to Win Carroll Smith, 1990

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Table of Contents Physics For Gearheads An Introduction To Vehicle Dynamics Energy And Power With Examples From Motorsports

1. Understanding the eBook Physics For Gearheads An Introduction To Vehicle Dynamics Energy And Power With Examples From Motorsports
 - The Rise of Digital Reading Physics For Gearheads An Introduction To Vehicle Dynamics Energy And Power With Examples From Motorsports
 - Advantages of eBooks Over Traditional Books
2. Identifying Physics For Gearheads An Introduction To Vehicle Dynamics Energy And Power With Examples From Motorsports
 - 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 an Physics For Gearheads An Introduction To Vehicle Dynamics Energy And Power With Examples From Motorsports
 - User-Friendly Interface
- 4. Exploring eBook Recommendations from Physics For Gearheads An Introduction To Vehicle Dynamics Energy And Power With Examples From Motorsports
 - Personalized Recommendations
 - Physics For Gearheads An Introduction To Vehicle Dynamics Energy And Power With Examples From Motorsports User Reviews and Ratings
 - Physics For Gearheads An Introduction To Vehicle Dynamics Energy And Power With Examples From Motorsports and Bestseller Lists
- 5. Accessing Physics For Gearheads An Introduction To Vehicle Dynamics Energy And Power With Examples From Motorsports Free and Paid eBooks
 - Physics For Gearheads An Introduction To Vehicle Dynamics Energy And Power With Examples From Motorsports Public Domain eBooks
 - Physics For Gearheads An Introduction To Vehicle Dynamics Energy And Power With Examples From Motorsports eBook Subscription Services
 - Physics For Gearheads An Introduction To Vehicle Dynamics Energy And Power With Examples From Motorsports Budget-Friendly Options
- 6. Navigating Physics For Gearheads An Introduction To Vehicle Dynamics Energy And Power With Examples From Motorsports eBook Formats
 - ePub, PDF, MOBI, and More
 - Physics For Gearheads An Introduction To Vehicle Dynamics Energy And Power With Examples From Motorsports Compatibility with Devices
 - Physics For Gearheads An Introduction To Vehicle Dynamics Energy And Power With Examples From Motorsports Enhanced eBook Features
- 7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Physics For Gearheads An Introduction To Vehicle Dynamics Energy And

Power With Examples From Motorsports

- Highlighting and Note-Taking Physics For Gearheads An Introduction To Vehicle Dynamics Energy And Power With Examples From Motorsports
- Interactive Elements Physics For Gearheads An Introduction To Vehicle Dynamics Energy And Power With Examples From Motorsports

8. Staying Engaged with Physics For Gearheads An Introduction To Vehicle Dynamics Energy And Power With Examples From Motorsports

- Joining Online Reading Communities
- Participating in Virtual Book Clubs
- Following Authors and Publishers Physics For Gearheads An Introduction To Vehicle Dynamics Energy And Power With Examples From Motorsports

9. Balancing eBooks and Physical Books Physics For Gearheads An Introduction To Vehicle Dynamics Energy And Power With Examples From Motorsports

- Benefits of a Digital Library
- Creating a Diverse Reading Collection Physics For Gearheads An Introduction To Vehicle Dynamics Energy And Power With Examples From Motorsports

10. Overcoming Reading Challenges

- Dealing with Digital Eye Strain
- Minimizing Distractions
- Managing Screen Time

11. Cultivating a Reading Routine Physics For Gearheads An Introduction To Vehicle Dynamics Energy And Power With Examples From Motorsports

- Setting Reading Goals Physics For Gearheads An Introduction To Vehicle Dynamics Energy And Power With Examples From Motorsports
- Carving Out Dedicated Reading Time

12. Sourcing Reliable Information of Physics For Gearheads An Introduction To Vehicle Dynamics Energy And Power With Examples From Motorsports

- Fact-Checking eBook Content of Physics For Gearheads An Introduction To Vehicle Dynamics Energy And Power With Examples From Motorsports
- Distinguishing Credible Sources

13. Promoting Lifelong Learning
 - Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
14. Embracing eBook Trends
 - Integration of Multimedia Elements
 - Interactive and Gamified eBooks

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