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Book Review

DYNAMICS OF GAMBLING: ORIGINS OF RANDOMNESS IN MECHANICAL SYSTEMS
Series: Lecture Notes in Physics, Vol. 792

J Strzalko, J Grabski, P Perlikowski, A Stefanski, and T Kapitaniak, Springer, 2009 (hardback), 152 pp
€59.95, ISBN: 978-3-642-03959-1

This book takes a mathematical approach to understand the dynamics of gambling. There are not many books on this topic and the authors have done an excellent job by introducing the theory in a structured and systematic manner. The theory presented in the book is a fusion of rigid body dynamics, mechanics, non-linear analysis, and probabilistic methods. Clear diagrams are used throughout the book. Mathematical notations are selected carefully so that they are institutive and straightforward. The quality of diagrams is particularly good, especially the 3D diagrams and the colour diagrams. Three types of dynamic systems, namely, throwing of a coin, motion of a dice, and the motion of a ball in roulette are discussed in details. The book is divided into five chapters and each chapter has its own reference list.

Chapter 1 introduces the topic and defines the scope of the book. A brief historical account of gambling is given to set the scene of the book. The important concept of mechanical randomizer is introduced and physical models for coin, dice, and roulette are proposed. The assumptions under which such models can be considered 'fair' are discussed. The ideas of dynamics and predictability and extreme sensitivity to the initial conditions are presented.

The basics of rigid body motion necessary to analyse the dynamic systems is given in Chapter 2. Newton–Euler equations in three dimensions are derived. Both Euler angles and Euler parameters (normalized quaternions) are used to describe the orientation of a rigid body in three dimensions. The precession of symmetric and asymmetric bodies is discussed with mathematical equations and clear diagrams. Forces and moments due to air resistance and a brief discussion on impacting bodies are also included.

Chapter 3, covering more than 50 pages of this 150-page book, is where the main equations governing the motion of the three systems considered are derived. The theory is developed by considering several special cases. For the coin motion problem, ideal coin, imperfect coin, 1D and 2D models, coin motion in the air, bouncing of the coin on the floor, and coin–air interaction were discussed. Illustrative diagrams were used to explain the coin motion. The motion of dice and ball in the roulette are also discussed with similar rigor and clarity.

The analysis presented in Chapter 3 is purely deterministic. The random dimension of the gambling problem is discussed in Chapter 4. Experimental observations and numerical simulations of the coin toss, dice throw and roulette run are presented. Sensitivity of the motion with respect to the initial condition is discussed in the light of non-linear dynamic analysis. Along with the mathematical derivations, excellent colour pictures are given to show the motion coin, dice and ball in the roulette. Different numerical values of the initial conditions are used in the plots to show the differences in the resulting motion.

Chapter 5 concludes the book with some further discussion on the nature and origin of randomness in mechanical systems. The authors argue that the non-smoothness of the system plays a key role in the occurrence of dynamical uncertainties.

In summary, this is a nice book on a specialized subject. Because of the very topic, the reviewer is not sure if it would be a direct recommendation in a teaching curriculum! However, the mathematical techniques of analytical dynamics and concept of randomness in mechanical systems can be very useful in the study of a variety of other academic topics such as flight mechanics of unmanned air vehicles (UAVs) and micro air vehicles.

S Adhikari
College of Engineering, Swansea University, UK