Spinning Flight: Dynamics of Frisbees, Boomerangs, Samaras and Skipping Stones

R.D. Lorenz

Springer NY, 233 Spring St. New York, NY 10013 USA. 346pp. Illustrated. £24. ISBN 0-387-30779-6.

This book is an admirable survey of almost every kind of spinning dynamics. But note that the classic hazard of autorotation with asymmetric aerodynamics is barely touched; it escapes total neglect by the inclusion of two old pictures of NACA upflow spin-test wind tunnels. That matters little in comparison with the modern topics brought forward here. The author is an aerospace engineer working in planetary science, specifically the Titan probe descending on a rotating parachute. Thinking through that project led him to explore, not always deeply, a wide field which encompassed frisbees as well as boomerangs and sycamore seeds. The exploration, apart from a handful of succinct equations, is non-mathematical.

There is an introduction giving basic rotational dynamics and discussing aerodynamic force and torque, drag, dimensionless parameters, lift, and the Magnus effect. Nutation is distinguished from coning. This basis of theory is commendably brief

The bulk of the book comprises twelve chapters covering a score of applications. A third of these deal with the recreational spinning objects: cricket, tennis, soccer and rugby footballs, golf balls, the baseball; then frisbees, freshly researched, boomerangs (both straight-flying and returning); the Aerobie (a descendent of the quoit with subtle aerodynamics), skipping i.e. skimming stones and clay 'pigeons'. Samaras, a class which includes sycamore seeds, are given their place. Many of these 'fun' objects have been instrumented for flight testing, exploiting miniaturisation. Techniques and results are given.

Selecting applications which are engineering money-earners highlights bouncing gasbags, 'tumbleweeds', rifle bullets, spinning bombs, bouncing bombs, some rockets, some satellites, asteroid and comet encounters (e.g. Giotto), planetary probes with spinning parachutes (Huygens/Titan). The large disc radomes prominently mounted on some surveillance aircraft are slipped in too.

This is a stimulating and readable book, perhaps the most comprehensive of its kind, with many illustrations. The author reminds us of many links between mere playthings and engineering solutions. The editors have duplicated some of the (greyish) photographs with an insert of colour plates. Some unimportant slips escaped their proof-reading net. There are many useful references after each chapter, appendices on instrumentation and photography and a good index.

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Introduction to Engineering Thermodynamics – Second edition

Fundamentals of Engineering Thermodynamics – Fifth edition

R.E. Sonntag and C. Borgnakke

M.J. Moran and H.N. Shapiro

John Wiley and Sons, The Atrium, Southern Gate, Chichester, West Sussex, PO19 8SQ, UK. 2006. 831pp. Illustrated. £36.99. ISBN 0-470-03037-2.

There are a great many thermodynamics texts available to engineering undergraduates. The two books under review here are aimed at undergraduate engineers and have been written by respected authors, all of whom have a long established pedigree in thermodynamics teaching.

Both texts cover the standard material. The Moran and Shapiro book provides a brief introduction to thermodynamics, dipping very quickly into applications from everyday life. This approach is pedagogically useful for two reasons; (1) the students gain a rapid appreciation for the wide spectrum of processes to which thermodynamics can be applied; (2) straight from the earliest parts of the book, students are encouraged via examples to develop a strong set of problem solving skills.

The Sonntag and Borgnakke book provides an alternative and equivalent introduction into the subject by spending more time developing fundamentals and introducing pure substances even before covering the first law. This second approach underlines the difficulty of teaching the very earliest stages of thermodynamics; in order to apply the First Law to engineering systems, one really requires knowledge of working fluids – but to define properties like internal energy for these fluids, one really requires knowledge of the First Law. The learning style of any student could be met by using both books in parallel. Often, one of the quickest ways of assessing the quality of a thermodynamics text lies in its treatment of the Second Law – an area which has historically proved the most challenging for students to grasp. Both books do an excellent job here.

The Moran and Shapiro book provides a more gradual introduction into the subject. Reversible and irreversible processes are discussed, and a number of useful examples are provided that allow students to understand these concepts before recourse to the full mathematical analysis. Sonntag and Borgnakke cover essentially the same material, but seem less afraid of using mathematics; the existence of entropy via the Clausius statement and cyclic integrals provides an excellent example of the kind of abstract thinking that advanced thermodynamics requires. The appearance of irreversibilities as a source term in the balance equation for entropy is discussed in both books; this area is a particular trouble spot for students who, having been brought up on the idea of conserved quantities in much of their analysis, find this point difficult to comprehend. What is particularly good about both books is the unified way in which this treatment is extended to later chapters, where 'modern' concepts such as availability and exergy are covered.

The latter chapters of both books go on to cover fairly standard material – psychrometry, gas mixtures, the Maxwell relations and equations of state, gas mixtures and combustion. The Moran and Shapiro book scores more highly here, as it covers aspects of compressible flow; this is particularly useful to aerospace undergraduates, and also serves to blur the artificial separation in students' minds between fluid mechanics and thermodynamics.

In summary, both texts are excellent sources for thermodynamics undergraduate (both have been used in the development of courses here at Manchester). The Moran and Shapiro book scores better for its many examples and slower development of the material. The Sonntag and Borgnakke book provides a better formal treatment and is more suited to the advanced undergraduate student.

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