global issues. Throughout, the responses from the cart–track system show an impressive degree of agreement with numerical simulations.

If this book has a weakness, it is in the presentation of the theory. However, it would be churlish to complain about this. My main regret would be that the author has shown us very little of his mastery of the mathematical basis of the subject. This has clearly been done with the intent of restricting the size of the book and bounding its expense. This course of action means that the book will fit well within the budget of today's students. A slight missed opportunity is the lack of discussion on some of the more essential aspects of the calculations. Indeed, in the appendix on a continuous system, the author alludes to "repeated difficulty (which) was encountered in ensuring convergence in the dimension and embedding calculations" without providing us with the benefit of his experience. However, as I said, I do not regard these criticisms as serious.

In summary, I am very impressed with this book and I would recommend it without reservation as part of the literature for a Mechanical Engineer embarking on the study of non-linear dynamical systems. Because of the de-emphasis on theory, I would recommend that it be read after one of the gentler mathematical introductions, for example the excellent reference [5]. After this, the reader will be better placed to approach the deeper studies.

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IMPACT MECHANICS, 2000, by W. J. Stronge, Cambridge: Cambridge University Press. xix + 280 pp. Price £42.50; US$69.95. ISBN 0-521-63286-2

Impact is one of the most universal and widespread mechanical phenomena. Through the centuries impact has played a key role in technology as an intensive and simple source of mechanical influence on materials, structures and processes. Its study influenced the formation of mechanics as a science. The increase in the speed, accuracy demands and environmental protection leads to the more deep penetration into the nature of impact processes with development of new models and analyzing techniques. Nowadays impact studies are basic in damage mechanics, machine dynamics, vibration engineering, and structural mechanics.

In spite of broad research activity in the investigation of different aspects of impact phenomena, there is still a need for some introductory books for advanced students and professionals which give a general state of the art of the subject and a quick route to professional applications. The current textbooks on mechanics offer traditionally simplified presentation of impact, which is far from the real complexity of its applications. The book

"Impact Mechanics" is intended to elucidate broadly the up-dated mechanical background of the subject.

The contents of the book are limited mainly by the analysis of local effects of low-speed collisions of bodies or structures without their damage or transformation. The analysis of impact in this case reduces to the calculation of the force factors developed during the collisions and their influence on the change of the main kinematic characteristics of the bodies or structures involved. Within the framework of such analysis the author describes consequently the different models of colliding systems in increasing complexity of their structure and conditions of impact. The material embraces all the main aspects of the problem which are systemized.

After an introduction into modelling and analysis of the mechanics of low-speed impact (Chapter 1), the author begins from the consideration of models of rigid bodies colliding under different angles of incidence. The chapters include collinear impact (Chapter 2), plain impact of smooth and rough bodies (Chapter 3) and spatial impact of rough bodies (Chapter 4). The detailed consideration of a friction effect due to the roughness of colliding surfaces is given on the base of the Amontons–Coulomb law. This permits an analysis of stick–slip phenomena due to impact within the models of rigid body mechanics using the coefficients of restitution and dry friction. For the separation of dissipative effect due to friction and plasticity the author proposes and systematically uses a special treatment of the coefficient of restitution as a measure of dissipation of energy due to hysteresis in the normal contact force. This controversial proposal can produce difficulties in the estimation of the work of the contact forces in complex conditions of impact loading of the material. Nevertheless, for many situations analyzed, this specific treatment gives the same results as the traditional use of the coefficient of restitution (Newton or Poisson hypotheses).

In Chapter 5 the author introduces rheological models of contact compliance of colliding rigid bodies as a combination of massless springs and dashpots. The analysis begins from the Maxwell model of visco-elastic contact. For this model, the resulting coefficient of restitution is independent of the incident relative velocity. In order to reflect an experimentally observable dependence of the coefficient of restitution on the incident velocity, the non-linear visco-elastic elements are introduced in the model of contact compliance. The graphs of a normal force as a function of indentation under different initial velocities of incidence for two different models are presented. They have a hysteresis loop with an area proportional to the energy of dissipation.

The author omitted, unfortunately, a consideration of a simple and realistic Kelvin–Voight visco-elastic contact because "this model gives a normal force which jumps to a finite value at the instant of incidence". This jump, however, is an experimental fact, which clearly manifests itself during the impact against different plastic pads. The Kelvin–Voight model also leads to a restitution coefficient which is independent of the impact velocity. The model is convenient for the analysis of impact with inner dissipation of energy in a material without damage. Contrary to this, the Maxwell model gives a residual deformation of the material after impact, which has to be calculated for every collision in the case of repeated impacts.

Essential attention is given to the effect of tangential compliance in a contact area. Different conditions of incidence due to combinations of the tangential and normal components of contact force are analyzed for collinear impact. This permits one to consider independently the normal and tangential motions as simple harmonic oscillations while a contact point sticks. The transition from stick to slip and vice versa during an impact is analyzed. Detailed numerical analysis is given for an oblique impact of an elastic sphere on a rough half space.

Chapter 6 is devoted to an analysis of local continuum deformation during an impact as an elastic, elastic–plastic and fully plastic process. This is a quasi-state compression in the contact area of colliding bodies, which allows an estimation of the energy losses due to the plastic deformation. The elastic deformation is described with Hertz theory. The elastic indentation is calculated till the stress pressure results in yield at a point beneath the contact surface. An analytical estimation for the pressure inside a plastic area leads to the calculation of the expression for normal contact force as a function of the indentation. Direct impact of elastic bodies and eccentric planar impact of rough elastic–plastic bodies are analyzed as examples. Analytical expressions for computation of the apparent coefficient of restitution for the latter case are proposed.

Chapter 7 describes the stress waves in solids coming out of the impact site. The models are limited to one-dimensional structures: rods and beams. The contents are based on the elementary theory of elastic waves. Different boundary conditions are introduced and stress analysis due to the propagation of waves generated by impact is performed. To reflect a contact compliance on a wave formation, the Hertzian contact model is used as a boundary condition. The comparison of three models for transverse waves in beams is discussed. They include Euler–Bernoulli, Rayleigh and Timoshenko beams. A short commentary on the influence of dispersion due to wave propagation is added. No mention has been made, unfortunately, about the surface waves which play an important role in impact dynamics.

Chapter 8 is devoted to the analysis of an impact against multi-body structures. The case of ideal bilateral constraints is treated within the framework of Lagrange mechanisms. Two instructive examples of impact of a pendulum and a double pendulum against a rough surface are presented. The author could add here an available analytical solution of the first problem in a more complex formulation when a pendulum on a moving platform impacts a rough abstacle. This can illustrate many mechanical situations due to impact of constrained bodies.

The following text is a topical scientific discussion about the validity of the different hypothesis for modelling multi-body systems with unilateral constraints. After a convincing demonstration of the defects of hypotheses of simultaneous or sequential response of contacting bodies, the author introduces a realistic mechanical model of a wave propagation in a system of flexibly connected rigid bodies. The analysis of the dispersion relation gives prognosis about the complex behaviour of the system, which demonstrates the dispersion of waves and localization of standing waves near the impact end. Similar effects were obtained previously in different non-linear lattices and correspond to the author's conclusions. The chapter finishes with the analysis of impact of a pendulum having compliance both in the impact area and in the pivot.

Chapter 9 describes the impact of flexible structures. A finite number of eigenmodes approximates the structural response. The number of influential modes depends on the duration of the contact. The presented analysis of the transverse impact of a sphere against a beam follows the Timoshenko recipe with the use of an integral equation. Both linear and Hertzian compliances are considered. The correlation between local compliance in the area of impact and global compliance of the supporting structure is discussed. This is limited mainly by extreme cases when a light mass strikes a heavy structure or a heavy mass impacts a slender beam. The influence of compliance of the structure on the contact process is given only by a numerical example. It would be preferable to give here some instructive analytical estimations of quasi-static and dynamic action of impact forces depending on the relation between the duration of impact and the natural oscillation periods of the structure. Such estimations are available in the literature.

Chapter 10 gives some simple examples of excitation by multi-impact processes. These include a ball bouncing down a flight, a prismatic cylinder rolling down a rough inclined plane, toppling and collisions of a chain of dominoes and forced vibration of a mechanical oscillator near a limiter. These systems tend asymptotically to some steady-state behavior with systematic impacts. This can be due to self-excitation or synchronization of periodically repeated interactions within the dissipative structures as well as due to chaotization of the motion through its strong sensitivity of perturbations. A propagation of a solitary wave in dominos is analyzed in detail with the calculation of the speed of propagation. A comparison with well-known results on the dynamics of a lattice would be pertinent here.

The dynamics of an impact oscillator is described in a sketchy manner omitting many important facts indicating a poor knowledge of the subject history and state of the art. There is no indication, for example, about the crucial influence of the initial gap, subharmonic motions, structural bifurcations due to additional penetrations of phase trajectory through the impact surface etc. Results about the stability and bifurcation of impact oscillator periodic motion indicated by the author's references were published in this and more general form 20–30 years earlier.

The book is concluded with two useful appendices presenting a history of the influence of impact studies on the formation of mechanics and a glossary of terms. The list of references is rather short for such a wide area of consideration.

The general scope of the material in the book is a significant supplement to the literature on the subject. The author did not try to avoid challengeable or discussible topics and many results presented reflect his own contribution or point of view. Some debatable considerations in the book reflect a vivid character of the material presented. The educational benefit of the book is increased by the solution of mutual instructive examples and by the supplement of every chapter with problems for exercises.

The mechanics of impact is the developing area on the cutting edge of modern technologies. It generates permanently new problems and fertilizes many adjoining areas of mechanics. The book will be an important aid for those entering or involved in this productive process as well as for graduate students and their instructors. This can be used as a textbook and a reference book and should be recommended for university and engineering libraries.

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FOUNDATIONS OF ENGINEERING ACOUSTICS, 2001, by F. Fahy, London: Academic Press. xix + 433 pp. Price £39.95; US$84.95. ISBN 0-12-247665-4

Professor Fahy is an internationally renowned specialist on acoustics and vibration and is well known both for his scholarship in acoustics and for his passion in teaching. These two aspects of his career make him ideally suited to write a new text book on the fundamentals of engineering acoustics. The book is intended as an advanced text for undergraduate students or as a core text for postgraduate students and this is reflected in the style and structure of the book. The book is wide-ranging covering a great number of acoustic subjects, namely the nature of sound and some wave phenomena, sound in fluids, impedance, sound energy and intensity, sources of sound, sound absorption and sound absorbers, sound in waveguides, sound in enclosures, structure-borne sound, transmission of sound through partitions, reflection scattering deflection and refraction as well as a number of appendices covering specialist areas such as Fourier transforms, frequency analysis etc.

As with most books, the text begins and progresses with simple ideas with each subsequent chapter building on some of the ideas and theories presented in earlier chapters.