Nonlinear Vibration with Control
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This book is organized into eight chapters, and a brief index. Every chapter ends with a section reviewing the topic and a list of references. The latter are mostly contemporary: not many pioneering works are referenced. There are problems for the students at the ends of Chapters 2, 3, and 4.

Chapter 1 is concerned with the introduction to nonlinear vibration and control. Topics, other than the chapter notes, covered in this chapter are vibration of flexible structures, causes of nonlinear vibration, mathematical models for vibration, control of nonlinear vibrations, continuous structural elements, and smart structures.

The title of Chapter 2 is "Nonlinear Vibration Phenomena" but a more appropriate title for this chapter would be "Nonlinear Vibration Phenomena and Analysis" or "Phenomena and Analysis of Nonlinear Vibration" or the like since the topics covered in this chapter are: State space analysis of dynamical systems, the link between state space and mechanical energy, multiple solutions, stability and initial conditions, periodic and non-periodic oscillations, parameter variation and bifurcations, and nonlinear phenomena in higher dimensions.

Chapter 3 deals with control of nonlinear vibrations. Topics in this chapter are: control design, stability theory, linearization using feedback, control of multi-degree-of-freedom (mdof) systems, and adaptive control. For mdof systems modal analysis is employed exclusively.

Approximate methods for analyzing nonlinear vibrations are introduced in Chapter 4. These include the backbone curves, harmonic balance, averaging, perturbation and normal form transformations. This latter topic is generally treated in courses on dynamical systems or a second course in differential equations within the domain of applied mathematics. For graduate students with an undergraduate engineering background it may be somewhat demanding. The amount of algebraic manipulation is substantial even with the assistance of a symbolic manipulation package such as Maple or Macsyma or Mathematica.

Modal analysis for nonlinear vibration is treated in Chapter 5. Modal decompositions applying linear techniques and for nonlinear systems are covered. Detailed steps for application of normal form transformations are included.

Chapter 6 is concerned with beams. Euler beam theory, nonlinear beam vibration, and case study of modal control applied to a cantilever beam are treated in this chapter.

Cable vibration is dealt with in Chapter 7. The foci in this chapter are nonlinear cable dynamics and case study of analysis of cable response. The commendable feature in this chapter is this latter topic in which results applying harmonic balance, averaging, multiple scale perturbation, and normal forms are compared.

Nonlinear vibration of plates and shells are treated in the last chapter, Chapter 8. Considering the nature and aims of this book the treatment may be appropriate. However, it is too brief to bring out the importance and many interesting phenomena in nonlinear vibration of plates and shells. It is even more ambitious for the authors to include a topic on adaptive structure applications.

Similar to many new books and especially those that deal with difficult, in the sense of requiring patience and perseverance, topics such as nonlinear vibration of plates and shells the book being reviewed has its fair share of errors. We point out or comment on the more important and obvious ones below.

In page 8, under the topic of causes of nonlinear vibration, external forces and constraints, it was stated that "… flutter is a classic case of a static equilibrium position becoming unstable when the system is subjected to certain dynamic excitations…." (third line from bottom of the topic paragraph). Strictly speaking, the "certain dynamic excitations" cannot be regarded as "external forces" they are the so-called parametric excitations. Besides, Hopf bifurcation is an applied mathematician term which, loosely speaking, can be applied to describe the flutter instability phenomenon but it is not the cause. Therefore, "This loss of stability occurs via a Hopf bifurcation" has a logical problem. It may be appropriate to note that flutter instability can occur in linear or pseudo-linear systems. For example, a cantilever pipe containing a moving fluid can has flutter instability when the speed of the moving fluid approaches a critical value.

In page 21, fifth line above Eq. (1.24), the definition of proportional or Rayleigh damping matrix is not a general one in the sense that once the first two modal damping ratios are specified the remaining modal damping ratios are not independent.

In Figure 4.7, page 163, the plot by using normal form solution has a problem between approximately 2.06 and 2.08 Hz. In this region the response is supposed to be unstable yet according to the plot it is stable. Of course, this is a reflection of the problem of employing normal form solution.

In page 188, nonlinear normal modes are dealt with. No mention was made in regard to the pioneering work of Rosenberg[1,2]. We feel he and his students made a major contribution and therefore his work should at least be quoted.

The normal form solution steps and the two dof nonlinear example introduced in pages 195 through 211 illustrate the usefulness and limitations of the normal form approach. It is well known that normal form solutions are not unique and can only be applied to systems with small nonlinearities. The amount of algebraic manipulation is substantial even for a two dof nonlinear system with the assistance a symbolic manipulation package.

On page 240, Figure 4.7 has a problem. The boundaries illustrated at both ends of the beam are not those of the clamped ones. To be consistent with the caption of the figure they should be corrected.

On page 267, dealing with the time-varying boundary conditions, a more rigorous theoretical basis for master degree level students can be found in the book by Meirovitch[3].

At the bottom of page 279 and top of page 280, it was stated that "Rearranging this equation gives…." But the "this," referring to the equation above the statement has no damping term although it was introduced after Eqn. (7.59). In other words, it may be written with the statement changed to, say, "Introducing the damping ratios into this equation and rearranging gives."

On page 288, eleventh line from the bottom, …The region…is dotted to indicate…. In Figure 7.9 there are two dotted lines instead of one. Of course, one is rather fainted or small and the other is more obvious. In other words, they should be distinguished.

In the first equation on page 293, the ε^2 term in the first brackets should be deleted since only the first two terms in the series are retained in the analysis. Furthermore, the last term in the third line on the left-hand side of this equation has a typographical error.

On page 299, the partial statement below the second equation reflects by deduction that even the normal form approach cannot applied to deal with the so-called 1:1 inner resonance case since the first order multiple scale method fails to provide the 1:1 inner resonance solution. This is the so-called non-semi-simple problem in the parlance of applied mathematics.

In Chapter 8, the nonlinearities in plates and shells are those of von Kármán and therefore the deformations are moderately large. The notation used here is confusing in that, for example, N_y denotes the force acting parallel to y-axis while M_y designates the moment per unit width about an axis perpendicular to the y-axis. In Figure 8.2 the moment on the left-hand side indicated is counter-clockwise while the cross-section of the plate on this side illustrated is sagging. Therefore, there is an inconsistency or perhaps we missed something here. On page 315, the sentence below Eqn. (8.29) is incorrect. Strictly speaking, the first term…represents the restoring force per unit area and the second term the inertia force per unit area.

In conclusion, a book on nonlinear vibration, that does not reference Minorsky[4], and stability analyses of beams, plates and shells that do not include Bolotin[5], has some serious holes, so to speak. The multi-modal structural vibration problems considered in Chapters 5, 6, 7 and 8 are mainly two or three mode cases. There are some errors, discussed above, but these would probably be caught by an instructor so, on balance, the materials covered in this book are about right for a graduate course under the same title.

REFERENCES

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