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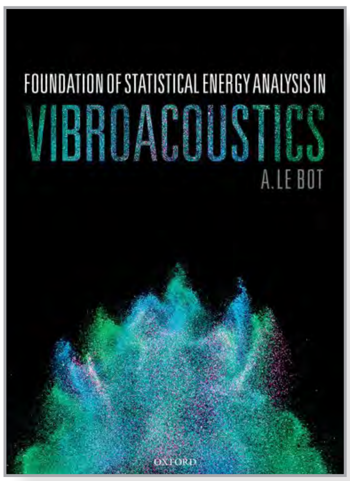
– Philip L. Marston, Book Review Editor

Foundations of Statistical Energy Analysis in Vibroacoustics



Author: A. Le Bot
Publisher: Oxford University Press, 2015
ISBN: 978–0198729235

Foundations of Statistical Energy Analysis in Vibroacoustics is an excellent elaboration on its title subject, not only in terms of providing those specific foundations but also at connecting them to relevant deterministic concepts while acknowledging the field's many contributors to both sets of disciplines. Readers might also be advised, however, of generalized Polynomial Chaos as a complementary, and possibly supplementary approach to the "propagation" of physical uncertainties throughout a complex system, including a structural one made up of lumped parameters (basic oscillators) coupled to wave-bearing distributed components.

Le Bot's book begins by laying out the necessary mathematics of Statistical Energy Analysis (SEA) and that makes the monograph self contained. There are occasional comments that one should take *cum grano salis*, as p. 7's promotion of Eqs. 1.25 and 1.26 as more "useful" [in practice] than Eq. 1.24's alternative, or Eq. 1.57's clipping off of its dummy-time's domain before *t*¼0 when its integral's limits would have respected causality just as much had they been expanded, and generalized, to [-1,*t*]. Equation 2.74 could be modified accordingly.

Another comment relates to Eq. 2.31's power balance for an isolated structural system. It might have been mentioned that an unbound acoustic medium either partially or wholly engulfing the structure would have contributed a radiated power Prad to the left side of Eqs. 2.102 and 2.104. It is true that these expressions are later extended in the analysis of transients, for which -*dE*/*dt* in Eq. 12.19, and þ*dE*/*dt* in Eq. 2.103, effectively replace Prad at either injecting or drawing energy into/from an equivalent group of resistive boundaries.

On the other side of the ledger, the book gives more than adequate attention to Skudrzyk's similarly acting structural energy sinks derived from the product of a [nominal] loss factor and the system's modal density (called a "fuzzy" in the later literature). The structure's mean response is then accurately supplied by the former's unbound version or behavior, often analytically available; cf. p. 203, which cites Skudrzyk's 1968 paper, which was later summarized and added to in that author's "The mean value method of predicting the dynamic response of complex vibrators," *Journal of Acoustical Society of America* 67(4), April 1980, pp. 1105–1135. I was particularly grateful for Le Bot's analysis of the effects on modal density of a structural system's two canonical, null (and therefore purely reactive) classes of boundaries, of which this reviewer was frankly unaware (Sec. 6.4, where Dirichlet boundaries embody zero stresses and maximum local displacements, versus Neumann ones, for which the reverse occurs).

Returning to the fundamental statistical mechanics underlying much of SEA, the book explains clearly, both quantitatively and qualitatively, the important role of white-noise driving conditions in eliciting energy sharing and equi-partitioning among a structure's possible types of local constitutive and/or inertia response, both "self" and interactive: First on pp. 25 and 39 (Eqs. 2.87 and 2.88), and later in Eq. 3.64 at the level of power, or energy—thereby retroactively justifying Dick Lyon's reference to these concepts in the book's praising Foreword in the context of equilibrium Thermodynamics.

In summary, this reviewer highly recommends Le Bot's new book to both students and seasoned analysts of the time-varying dynamics of complex structures. It does a fine job in its description of the insightful issue from the marriage of the deterministic to the statistical, the continuous to the discrete, and the sharp-harmonic to the spectral shot-gun blast of a frequency-flat stochastic input.

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*[Published online August 9, 2016,
Journal of Acoustical Society of America. 140 (2)]*