Preface

The use of symplectic space has been exploited in a number of fields in physics for many years particularly in quantum mechanics including the famous Yang-Mills field, relativity, gravitation, astrophysics, classical mechanics, etc. "Symplectic" is a Greek word which was first introduced in 1939 by Hermann Weyl in *The Classical Groups, Their Invariants and Representations*. In elasticity, symplectic approach was first applied in the early 1990s by one of the authors, Professor W. Zhong, to describe a new approach for solving basic problems in solid mechanics which have long been bottlenecks in the history of elasticity. It is based on Hamiltonian principle with Legendre's transformation whereby analytical solutions could be obtained by expansion of eigenfunctions. The methodology is rational and systematic with clear step-by-step derivation procedure. The advantage of symplectic approach with respective to classical approach by semi-inverse method is at least three-fold. First, the symplectic approach alters the classical practice and concept of solution methodology and hence allows the many basic problems previously unsolvable or too complicated to be solved be resolved accordingly. For instance, the conventional approach in plate and shell theories by Timoshenko has been based on the semi-inverse method with trial 1D or 2D displacement functions, such as Navier's method and the Levy's method for plates. The trial functions, however, do not always exist except in some very special cases of boundary conditions such as plates with two opposite sides simply supported. Using the symplectic approach, trial functions are no longer required. Second, it consolidates the many seemingly scattered and unrelated solutions of rigid body movement and elastic deformation by mapping with a series of zero and nonzero eigenvalues. Last but not least, the Saint-Venant problems for plain elasticity and elastic cylinders can be described in a new system of equations and solved. The difficulty of satisfying end boundary conditions in conventional problems which could only be covered using the Saint-Vanent principle can also be solved.

In this book, the authors' main objective is to introduce the major concepts and application of symplectic elasticity through discussion in some classical topics in elasticity. The rational approach of symplectic methodology has been very clearly elaborated in the selected examples. It should be emphasized that the potential of symplectic methodology for deriving analytical solutions is far more than what have been presented in this book. It has been applied by the authors and others not only in more complicated elasticity problems in thin and think plates with mixed boundary, shells, piezoelectric structures, but also in anisotropic structures, vibration and nonlinear dynamics, control theory, electromagnetism, waveguide, nanomechanics, quantum mechanics etc. The major parts of the topics will be disseminated through various scientific and technical conferences and journals and the contents will be included in a future manuscript when the theory becomes mature.

This book targets readers in engineering mechanics, nanomechanics, applied mathematics, engineering structures at postgraduate and research levels. Teachers at higher institutions may also find this book valuable for either teaching or reference. The contents are also beneficial to relevant parties in other disciplines such as physics, control, electronics, etc.

This book on symplectic elasticity was first published in Chinese entitled《辛弹性力学》by Higher Education Press in 2002. As it is a new approach with great research potential for further development and breakthrough is unavailable to many researchers in the field who have no access to Chinese language and literature, effort was initiated to translate the original manuscript into English to arouse the interest of many researchers and to promote better, wider and faster research progress using symplectic approach in elasticity.

In this English edition, a number of printing errors in the Chinese edition have been duly corrected. The authors are grateful to Professor L.H. He, Dr Ziran Li, Dr Chao-Feng Lü, Miss Ling Qiao and Professor Baisheng Wu for assisting in the translation and/or proofreading, in one way and another. Appreciation should also be extended to Higher Education Press, Beijing, for granting permission to publish this translated English edition.

Weian Yao
Wanxie Zhong
Chee Wah Lim
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