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**Complementary  
Variational  
Principles**

A. M. ARTHURS

# Complementary Variational Principles

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## **Complementary Variational Principles:**

**Complementary Variational Principles** A. M. Arthurs, 1980 Complementary Variational Principles Arnold Magowan Arthurs, 1970 **On Complementary Variational Principles** Louis B. Rall, WISCONSIN UNIV MADISON MATHEMATICS RESEARCH CENTER., 1965 Variational problems which are formulated in terms of finding maxima or minima of functionals usually lead to only one sided bounds for approximate solutions It has been shown recently by B Noble that a number of variational problems may be formulated in terms of complementary variational problems the approximate solutions of which give both upper and lower bounds for the desired stationary value In this paper complementary variational principles are formulated abstractly in Hilbert space Necessary and sufficient conditions are given for a system of two equations to represent a variational principle and sufficient conditions are given for the variational principle to be complementary Author *Complementary Variational Principles* G. P. Srivastava, R. A. H. Hamilton, 1978

**Complementary Variational Principles for Some Boundary Value Problems**, 1974 **Complementary Variational Principles for Boundary Value Problems** I B. Noble, WISCONSIN UNIV MADISON MATHEMATICS RESEARCH CENTER., 1964 In this series of papers a general variational principle and two complementary variational principles are developed for the simultaneous equations  $Tp$  partial derivative of  $W \times p \times u$  with respect to  $u$  and  $Su$  partial derivative of  $W \times p \times u$  with respect to  $p$  where  $T$   $S$  are linear operators and  $S$  is the adjoint of  $T$  The resulting formulae are of wide applicability and include most of the complementary variational principles which occur in applied mathematics In this paper the implications of the variational principles are worked out in some detail when  $T \frac{d}{dx} S \frac{d}{dx}$  including a discussion of extra terms which are required to deal with general boundary conditions **Complementary Variational Principles and Bounds to Eigenvalues** Friedrich Goerisch, Sabine Zimmermann, 1985 *Complementary Variational Principles in Elasticity and Plasticity* K. Washizu, 1977 *Complementary Variational Principles* Ben Noble, University of Wisconsin--Madison. Mathematics Research Center, 1966 *Complementary Variational Principles Applied to Boundary Value Problems in Mathematical Physics* C. W. Coles, 1972 Complementary Variational Principles Waldemar Velte, 1986 Complementary Variational Principles II Ben Noble, WISCONSIN UNIV MADISON MATHEMATICS RESEARCH CENTER., 1966 A unified theory of complementary variational principles is developed for problems in electrical networks mechanical structures and problems in economics that can be formulated in terms of network flow Author Complementary Variational Principles and Nonconforming Trefftz Elements B. Werner, 1981 On Dual-Complementary Variational Principles in Mathematical Physics John Tinsley Oden, Junuthula Narasimha Reddy, ALABAMA UNIV HUNTSVILLE SCHOOL OF GRADUATE STUDIES AND RESEARCH., 1973 A study of boundary value problems involving  $T$   $T$  operators is given Problems in mathematical physics can be decomposed into 3 canonical equations Variational principles can be developed corresponding to these equations Likewise for any operator  $T$  one can construct a

dual pair of operators  $S$   $S^*$  A dual system of canonical equations can be developed with corresponding variational principles. Consequently a set of 8 complementary and dual complementary variational principles suggest themselves. A number of applications are cited together with extensions of nonlinear problems. Author: Complementary variational principles and nonconforming Trefftz elements Bodo Werner, 1981 *Complementary Variational Principles and the Finite Element Method* Andrew Riley, 1977 *A Mathematical Theory of Complementary-dual Variational Principles and Mixed Finite-element Approximations ...*, 1973 Variational Principles of Theory of Elasticity with Applications Haichang Hu, 1984 **On Complementary Variational Principles and Hypercircle Estimates with Applications to Obstacle Problems** Bodo Werner, 1978

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