

Article

Variational Estimation Methods for Sturm–Liouville Problems

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Abstract: In this paper, we are concerned with approach solutions for Sturm–Liouville problems (SLP) using variational problem (VP) formulation of regular SLP. The minimization problem (MP) is also set forth, and the connection between the solution of each formulation is then proved. Variational estimations (the variational equation associated through the Euler–Lagrange variational principle and Nehari’s method, shooting method and bisection method) and iterative variational methods (He’s method and HPM) for regular RSL are unitary presented in final part of the paper, which ends with applications.

Keywords: BVP nonlinear problems; variational methods; estimating nonlinearities; Green function

MSC: 34A12; 34A45



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1. Introduction

Nonlinearities are different from linear type by a function, an operator or a system that is nonlinear or is the case in which only some characteristics of it are known. The existence of the solution and the dependence of conditions for solving some classes of differential equations described by an operator is specified by the general framework of the Sturm–Liouville problem, with parametric conditions at the limit. The general framework of the Sturm–Liouville problem with parametric conditions at the limit is specified in the first part of the paper. The existence of the solution and the dependence of conditions is specified through the connection between the differential operator and Green’s function. Based on the properties of Green’s function, the operator used to analyze the behavior of the solution of the parameters given by the boundary conditions is specified. Variational problems derived from the initial RSLP are outlined with different type conditions in order to estimate the solution.

Let be the operator $L = -\frac{d}{dx} \left[p(x) \frac{d}{dx} \right] + q(x)$ as part of the regular Sturm–Liouville problem (RSL). The Sturm–Liouville (SL) problem expressed by the differential equation and the boundary conditions

$$a(x) \frac{d^2 u}{dx^2} + b(x) \frac{du}{dx} + c(x)u - \lambda d(x)u = 0, \quad (1)$$

$$\begin{aligned} B_1 : & \alpha_1 u(a) + \alpha_2 u'(a) = 0, \quad |\alpha_1| + |\alpha_2| \neq 0, \alpha_1, \alpha_2 \in \mathbb{R}, \\ B_2 : & \beta_1 u(b) + \beta_2 u'(b) = 0, \quad |\beta_1| + |\beta_2| \neq 0, \beta_1, \beta_2 \in \mathbb{R} \end{aligned} \quad (2)$$

could be written as

$$Lu + \lambda s(x)u = 0, \quad x \in (a, b) = I, \lambda \in \mathbb{R} \quad (3)$$

Stable Methods For Illposed Variational Problems

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Stable Methods For Illposed Variational Problems:

The book delves into Stable Methods For Illposed Variational Problems. Stable Methods For Illposed Variational Problems is a vital topic that must be grasped by everyone, ranging from students and scholars to the general public. This book will furnish comprehensive and in-depth insights into Stable Methods For Illposed Variational Problems, encompassing both the fundamentals and more intricate discussions.

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 - Chapter 1: Introduction to Stable Methods For Illposed Variational Problems
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 - Chapter 3: Stable Methods For Illposed Variational Problems in Everyday Life
 - Chapter 4: Stable Methods For Illposed Variational Problems in Specific Contexts
 - Chapter 5: Conclusion
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