Agrawal, O. P.

General formulation for the numerical solution of optimal control problems. (English)

Zbl 0679.49031
Int. J. Control 50, No. 2, 627-638 (1989).

Summary: A new improved computational method for a class of optimal control problems is presented. The state and the costate (adjoint) variables are approximated using a set of basis functions. A method, similar to a variational virtual work approach with weighing coefficients, is used to transform the canonical equations into a set of algebraic equations.

The method allows approximating functions that need not satisfy the initial conditions a priori. A Lagrange multiplier technique is used to enforce the terminal conditions. This enlarges the space from which the approximating functions can be chosen. Orthogonal polynomials are used to obtain a set of simultaneous equations with fewer nonzero entries. Such a sparse system results in substantial computational economy.

Two examples, a time-invariant system and a time-varying system with quadratic performance index, are solved using three different sets of orthogonal polynomials and the power series to demonstrate the feasibility and efficiency of this method.

MSC:

49M29 Numerical methods involving duality
49J15 Existence theories for optimal control problems involving ordinary differential equations
33C45 Orthogonal polynomials and functions of hypergeometric type (Jacobi, Laguerre, Hermite, Askey scheme, etc.)

Keywords:

variational virtual work approach; canonical equations; Lagrange multiplier technique; Orthogonal polynomials; time-invariant system; time-varying system; quadratic performance

Full Text: DOI

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