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QUADRATIC INTERNAL MODEL PRINCIPLE IN MATHEMATICAL PROGRAMMING

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Rezumat. *Demonstrăm că pentru problemele de programare matematică continue un algoritm de optimizare trebuie să încapsuleze într-o manieră explicită sau implicită un model intern pătratic al problemei de rezolvat care reprezintă esenţa problemei din punctul de vedere al algoritmului de optimizare. Modelele de optimizare se scriu pe baza legilor de conservare. Pentru acele sisteme care verifică principiul minimei acţiuni, teorema Noether exprimă echivalenţa dintre legile de conservare şi simetrii. Dar matematic simetriile sunt exprimate prin forme pătratice. Deci, la baza oricărui model real de optimizare se află o formă pătratică. Principiul modelului intern pătratic zice că această formă pătratică modificată pentru a include principalele ingrediente ale algoritmului de optimizare reprezintă modelul intern pătratic al algoritmului de optimizare.*

Abstract. *We show that for mathematical programming problems an optimization algorithm must encapsulate implicitly or explicitly a quadratic internal model of the problem to be solved which represents the essence of the problem from the view point of the algorithm. Optimization models are coming from the conservation laws. For systems which obey the principle of least action the Noether's theorem expresses the equivalence between the conservation laws and symmetries. But mathematically, symmetries are expressed by quadratic forms. Therefore, at the heart of every real optimization model is a quadratic form. The quadratic internal model principle says that this quadratic form modified in order to imbed the main ingredients of the optimization algorithm represents the quadratic internal model of the optimization algorithm.*

Keywords: Nonlinear optimization, line search methods, Newton system, quadratic programming, Noether theorem

1. Introduction

Starting with an initial point x_0 every algorithm for solving the general continuous nonlinear optimization problem

$$\min f(x)$$

subject to (1)

$$h(x) = 0,$$

where $f : R^n \to R$ and $h : R^n \to R^m$, can be considered as a generator of a sequence of points $\{x_k\}$ which satisfy the constraints of the problem in such a

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