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## APPLICATIONS OF INTERVAL COMPUTATIONS: AN INTRODUCTION

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### ABSTRACT

The main goal of this introduction is to make the book more accessible to readers who are not familiar with interval computations: to beginning graduate students, to researchers from related fields, etc. With this goal in mind, this introduction describes the basic ideas behind interval computations and behind the applications of interval computations that are surveyed in the book.

### 1 WHAT ARE INTERVAL COMPUTATIONS?

*The Majority Of Real-Life Application Problems Lead  
To (Constrained Or Unconstrained) Global  
Optimization*

In a typical real-life application problem, we need to find an alternative  $x$  that satisfies given constraints and that optimizes the value of a given characteristic  $y = f(x)$  (the optimized function  $f(x)$  is usually called an *objective function*). For example:

- in *data processing*, we must find a model  $x$  that best fits the known data; in this case,  $f(x)$  describes how well  $x$  fits;

# Applications Of Interval Computations

**V. Kreinovich, A.V. Lakeyev, J.  
Rohn, P.T. Kahl**



## **Applications Of Interval Computations:**

**Applications of Interval Computations** R. Baker Kearfott, V. Kreinovich, 2013-12-01 Primary Audience for the Book Specialists in numerical computations who are interested in algorithms with automatic result verification Engineers scientists and practitioners who desire results with automatic verification and who would therefore benefit from the experience of successful applications Students in applied mathematics and computer science who want to learn these methods Goal Of the Book This book contains surveys of applications of interval computations i e applications of numerical methods with automatic result verification that were presented at an international workshop on the subject in El Paso Texas February 23-25 1995 The purpose of this book is to disseminate detailed and surveyed information about existing and potential applications of this new growing field Brief Description of the Papers At the most fundamental level interval arithmetic operations work with sets The result of a single arithmetic operation is the set of all possible results as the operands range over the domain For example  $0.9 \leq x \leq 1.2$  and  $3.8 \leq y \leq 4.2$  where  $3.8 \leq x \leq 4.2$  and  $0.9 \leq y \leq 1.1$  and  $y \in [3.8, 4.2]$  The power of interval arithmetic comes from the fact that i the elementary operations and standard functions can be computed for intervals with formulas and subroutines and ii directed roundings can be used so that the images of these operations e g

**Theories of Interval Arithmetic** Hend Dawood, 2011-10-07 Scientists are all the time in a struggle with uncertainty which is always a threat to a trustworthy scientific knowledge A very simple and natural idea to defeat uncertainty is that of enclosing uncertain measured values in real closed intervals On the basis of this idea interval arithmetic is constructed The idea of calculating with intervals is not completely new in mathematics the concept has been known since Archimedes who used guaranteed lower and upper bounds to compute his constant Pi Interval arithmetic is now a broad field in which rigorous mathematics is associated with scientific computing This connection makes it possible to solve uncertainty problems that cannot be efficiently solved by floating point arithmetic Today application areas of interval methods include electrical engineering control theory remote sensing experimental and computational physics chaotic systems celestial mechanics signal processing computer graphics robotics and computer assisted proofs The purpose of this book is to be a concise but informative introduction to the theories of interval arithmetic as well as to some of their computational and scientific applications Editorial Reviews This new book by Hend Dawood is a fresh introduction to some of the basics of interval computation It stops short of discussing the more complicated subdivision methods for converging to ranges of values however it provides a bit of perspective about complex interval arithmetic constraint intervals and modal intervals and it does go into the design of hardware operations for interval arithmetic which is something still to be done by computer manufacturers Ramon E Moore The Founder of Interval Computations Professor Emeritus of Computer and Information Science Department of Mathematics The Ohio State University Columbus U S A A popular math oriented introduction to interval computations and its applications This short book contains an explanation of the need for interval computations a

brief history of interval computations and main interval computation techniques It also provides an impressive list of main practical applications of interval techniques Vladik Kreinovich International Journal of Uncertainty Fuzziness and Knowledge Based Systems Professor of Computer Science University of Texas at El Paso El Paso Texas U S A I am delighted to see one more Egyptian citizen re entering the field of interval mathematics invented in this very country thousands years ago Marek W Gutowski Institute of Physics Polish Academy of Sciences Warszawa Poland Complex Interval Arithmetic and Its Applications Miodrag Petković, Ljiljana D. Petkovic, 1998 The aim of this book is to present formulas and methods developed using complex interval arithmetic While most of numerical methods described in the literature deal with real intervals and real vectors there is no systematic study of methods in complex interval arithmetic The book fills this gap Several main subjects are considered outer estimates for the range of complex functions especially complex centered forms the best approximations of elementary complex functions by disks iterative methods for the inclusion by polynomial zeros including their implementation on parallel computers the analysis of numerical stability of iterative methods by using complex interval arithmetic and numerical computation of curvilinear integrals with error bounds Mainly new methods are presented developed over the last years including a lot of very recent results by the authors some of which have not been published before **Minisymposium on Applications of Interval Computations at the Third World Congress of Nonlinear Analysts**, 2001 *Computational Complexity and Feasibility of Data Processing and Interval Computations V.* Kreinovich, A.V. Lakeyev, J. Rohn, P.T. Kahl, 2013-06-29 Targeted audience Specialists in numerical computations especially in numerical optimization who are interested in designing algorithms with automatic result verification and who would therefore be interested in knowing how general their algorithms call in principle be Mathematicians and computer scientists who are interested in the theory of computing and computational complexity especially computational complexity of numerical computations Students in applied mathematics and computer science who are interested in computational complexity of different numerical methods and in learning general techniques for estimating this computational complexity The book is written with all explanations and definitions added so that it can be used as a graduate level textbook What this book is about Data processing In many real life situations we are interested in the value of a physical quantity  $y$  that is difficult or even impossible to measure directly For example it is impossible to directly measure the amount of oil in an oil field or a distance to a star Since we cannot measure such quantities directly we measure them indirectly by measuring some other quantities  $X_i$  and using the known relation between  $y$  and  $X_i$  to reconstruct  $y$  The algorithm that transforms the results  $X_i$  of measuring  $X_i$  into an estimate  $f_j$  for  $y$  is called data processing

## Embracing the Tune of Phrase: An Mental Symphony within **Applications Of Interval Computations**

In some sort of used by displays and the ceaseless chatter of quick transmission, the melodic beauty and psychological symphony created by the prepared term often disappear in to the backdrop, eclipsed by the relentless sound and disruptions that permeate our lives. Nevertheless, located within the pages of **Applications Of Interval Computations** a stunning literary treasure overflowing with raw emotions, lies an immersive symphony waiting to be embraced. Crafted by a wonderful musician of language, this captivating masterpiece conducts viewers on a mental trip, skillfully unraveling the hidden tunes and profound impact resonating within each cautiously constructed phrase. Within the depths with this emotional assessment, we will examine the book is main harmonies, analyze its enthralling writing model, and submit ourselves to the profound resonance that echoes in the depths of readers souls.

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