Numerical Software: Design, Analysis and Verification
4–6 July 2012, Santander (Spain).

Tradeoffs between Accuracy and Efficiency for Interval Matrix Multiplication

Nathalie Revol[1]

[1] *INRIA - LIP, ENS de Lyon,*
University of Lyon, France

emails: Nathalie.Revol@ens-lyon.fr

Abstract

Interval arithmetic is mathematically defined as set arithmetic. For implementation issues, it is necessary to detail the representation of intervals and to detail formulas for the arithmetic operations. Two main representations of intervals are considered here: inf-sup and mid-rad. Formulas for the arithmetic operations, using these representations, are studied along with formulas that trade off accuracy for efficiency. This tradeoff is particularly blatant on the example of interval matrix multiplication, implemented using floating-point arithmetic: according to the chosen formulas, the efficiency as well as the accuracy can vary greatly in practice, and not necessarily as predicted by the theory. Indeed, theoretical predictions are often based on exact operations, as opposed to floating-point operations, and on operations count, as opposed to measured execution time. These observations and the recommendations that ensue are further obfuscated by considerations on memory usage, multithreaded computations... when these algorithms are implemented on parallel architectures such as multicores.