Interval Finite Element Method

Leobardo Valera Martine Ceberio

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Ordinary differential equations and partial differential equations can be used to model complex physical simulations, such as combustions JP-8 fuels. Real fuels are chemically complex and often contain thousands of hydrocarbon compounds. Simulations of these kind of models are complex due to the difficulty of capturing uncertainty.

In this presentation, we use a transitory nonlinear heat equation as mock-up problem that mimics the fundamental physics of combustions, and we introduce the Interval Finite Element Method to determine the envelope where the solution lies.

We propose a novel technique to handle uncertainty in FEM using interval computations and Interval Constraint Solving Techniques[1, 2]. We then demonstrate the performance of our work on two problems: a static convection-diffusion problem and atransitory nonlinear heat equation as a first step towards our goal of fuel simulation.

References

[1] Granvilliers L, Benhamou F. *Realpaver: an Interval Solver Using Constraint Satisfaction Techniques*, ACM Transactions on Mathematical Software (TOMS), New York, NY. 2006. 32, 1. 138–156.

[2] Ceberio M, Granvilliers L. *Horner's Rule for Interval Evaluation Revisited* Computing, Austria. 2002. 69, 1. 51–81.