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Combining Interval, Probabilistic, and Other Types of Uncertainty in Engineering Applications

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Abstract

In many practical applications, we process measurement results and expert estimates. The measurements and expert estimates are never absolutely accurate, and their results are slightly different from the actual (unknown) values of the corresponding quantities. It is therefore desirable to analyze how these measurement and estimation inaccuracies affect the results of data processing.

There exist numerous methods for estimating the accuracy of the results of data processing under different models of measurement and estimation inaccuracies: probabilistic, interval, and fuzzy. To be useful in engineering applications, these methods should provide accurate estimate for the resulting uncertainty, should not take too much computation time, should be understandable to engineers, and should be sufficiently general to cover all kinds of uncertainty.

In this book, on several case studies, we show how we can achieve these four objectives. We show that we can get more accurate estimates, for example, by properly taking model inaccuracy into account. We show that we can speed up computations, e.g., by processing different types of uncertainty separately. We show that we can make uncertainty-estimating algorithms more understandable, e.g., by explaining the need for non-realistic Monte Carlo simulations. We also analyze how to make decisions under uncertainty and how general uncertainty-estimating algorithms can be.