CDF-Intervals: A Reliable Framework to Reason about Data with Uncertainty

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Abstract

This research introduces a new constraint domain for reasoning about data with uncertainty. It extends convex modeling with the notion of p-box to gain additional quantifiable information on the data whereabouts. Unlike existing approaches, the p-box envelops an unknown probability instead of approximating its representation. The p-box bounds are uniform cumulative distribution functions (*cdf*) in order to employ linear computations in the probabilistic domain. The reasoning by means of p-box *cdf*-intervals is an interval computation which is exerted on the real domain then it is projected onto the *cdf* domain. This operation conveys additional knowledge represented by the obtained probabilistic bounds. Empirical evaluation shows that, with minimal overhead, the output solution set realizes a full enclosure of the data along with tighter bounds on its probabilistic distributions.

KEYWORDS: convex structures, reliable constraint reasoning, probability box, *cdf* interval, constraint satisfaction problem, constraint programming, constraint reasoning, uncertainty