Propagating Range (Uncertainty) and Continuity Information Through Computations: From Real-Valued Intervals to General Sets

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One of the main problems of interval computations is to find an enclosure $Y \supseteq f(X_1, \ldots, X_n)$ for a range of a given function $f(x_1, \ldots, x_n)$ over given intervals $X_1, \ldots, X_n$. Most of the techniques for estimating this range are based on propagating the range through computations. Specifically, we follow the computations of $f(x_1, \ldots, x_n)$ step-by-step: we start with ranges $X_1, \ldots, X_n$ of the inputs, and then we sequentially compute the enclosures for the ranges of all intermediate results, until, on the last computation step, we get the desired enclosure $Y$. A similar propagation of “decorations” – information about continuity – enables us to make conclusions about the continuity of the resulting function $f(x_1, \ldots, x_n)$. In this talk, we show that the interval propagation results can be naturally extended to the general case of arbitrary sets. For this general case, we provide necessary and sufficient conditions for such a propagation.