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INTERVAL FIELD METHODS WITH LOCAL GRADIENT CONTROL

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Abstract.

This paper introduces a novel method to create an interval field based on measurement data. Such interval fields are typically used to describe a spatially distributed non-deterministic quantity, e.g., Young's modulus. The interval field is based on a number of measurement points, i.e., control points, expended throughout the domain by a set of basis functions. At the control point the non-deterministic quantity is known and bounded by an interval. However, at these measurement points information about the gradients might also be available. In addition, the non-deterministic quantity might be described better by estimating the gradients based on the other measurements.

Hence, the proposed interval field method allows to incorporate this gradient information. The method is based on Inverse Distance Weighing (IDW) with an additional set of basis functions: one set of basis functions interpolates the value, and the second set of basis functions controls the gradient at the control points. The additional basis functions can be determined in two distinct ways: first, the gradients are available or can directly be measured at the control point, and second, a weighted average is taken with respect to all control points within the domain. In general, the proposed interval field provides a more versatile definition of an interval field compared to the standard implementation of inverse distance weighting. The application of the interval field is shown in a number of one-dimensional cases where a comparison with standard inverse distance weighting is made. In addition, a case study with a set of measurement data is used to illustrate the method and how different realisations are obtained.