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Improving implicit geologic models based on data configuration

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Implicit methods have been the basis of many developments in 3-D structural geologic modeling. Typical input data for these types of models include surface points and orientations of geologic units, as well as the corresponding age relations (stratigraphic pile). In addition, the range of influence of input points needs to be defined, but it is difficult to infer a reasonable stationary estimate from data with highly variable configuration.

Often, this results in models that show artefacts due to data configuration including oversimplified results (underfitting) in areas where data is missing, overcomplex results (overfitting) in areas of high data density and geologically unreasonable surface shapes.

In this work we explore various methods to improve 3-D implicit geologic modeling by manipulating the data configuration using locally varying anisotropic kernels and kernel density estimation. In other words, the influence of input data in the interpolation is weighted based on directions and data density. Input parameters for these methods can either be based on the original input data configuration, inferred from additional supportive data, or be based on geologic expert knowledge. The proposed methods aim to increase model control while retaining the key advantages of implicit modeling.

Model improvements will be shown using a set of typical geologic structures and regularly occurring artefacts. We compare results to previously proposed methods that integrate anisotropies in traditional kriging applications and discuss the specific requirements for applicability in implicit structural geomodeling.