SOME PROBLEMS IN THE MAPPING OF GEOLOGICAL SURFACES

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ABSTRACT

Most geological surfaces are sampled from drill hole or outcrop observations, and frequently multiple surfaces are recorded in the course of the same project. To complicate matters, information for all desired surfaces is frequently not available at every site.

Despite the development of more sophisticated techniques (local patches, kriging) simple weighted average techniques are still the most widely used. Perhaps one reason is that geological data sampling is notoriously ill-distributed and rarely samples a surface well enough to delineate even the wavelengths of interest. Consequently the methods used for CAD are rarely appropriate. Kriging methods, while in fact of weighted average type, require more manual intervention than is usually feasible. The worst problem of weighted average methods, that surfaces fail to pass precisely through the data points, is serious for oil industry users but can be eliminated by modifying the traditional rectangular-grid sampling scheme. A second problem, the selection of a suitable set of neighbouring data points to have non-zero weightings, can be handled with an appropriate data structure (e.g. triangulation). Most schemes for calculating the individual weightings are, however, rather arbitrary. However the set of non-zero weightings is achieved, the result is a weighting to be applied to each surface estimate derived from a neighbouring data point. This estimate may be the data point elevation, a projected value using slope estimates at each data point, or even a discrete value such as rock type.

Once the set of weights and surface estimates has been calculated, normally a weighted mean is the only value calculated. It is perfectly feasible, however, to estimate other statistical parameters, such as variance, from the same information. In addition, any particular contributing data point can be eliminated if it is beyond some specified boundary, falls outside the permissible range set by the under and overlying surfaces, etc.

Given the availability of this kind of information many useful operations may be performed. Error estimates can be made, either at data points themselves or at intermediate locations. Variance maps may indicate surface discontinuities or invalid data. And, finally, the neighbour selection and weighting function procedures themselves may be evaluated in terms of their contribution to overall map variance. The opportunity clearly exists for evaluating even these elementary techniques in an easily comprehensible and systematic fashion.