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Estimation of geologic boundary based on bi-cubic B-spline for construction of high-resolution 3D geologic model

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A three dimensional (3D) modeling of geologic structure is quite effective in the fields of disaster assessment, environment conservation and resource management. Geologic boundary surfaces given by a form of a DEM (Digital Elevation Model) are necessary to construct the 3D geologic model.
In this presentation, we propose an estimation algorithm for geologic boundary surfaces based on a bi-cubic B-spline function. The algorithm is designed to express the surfaces in a form of a bi-cubic B-spline function, to determine an optimal surface based on exterior penalty function method using equality-inequality elevation information and slope information as constraints of the surface and to produce a set of coefficients that defines a bi-cubic B-spline function of the optimal surface. The present ideas enable us to determine a optimal geologic boundary without approximate calculation, to save the memory usage in estimation procedures and to keep the optimal surface as a mathematical function with continuity up to the partial derivatives of second order. This contributes to an estimation of geologic boundaries without any errors derived from approximate calculation and a generation of high-resolution DEM, and leads to a construction of high-resolusion 3D geologic model.