



P2P Tools

# Surface Slope Removal – SR Tool

## User's Manual

Version 1.50

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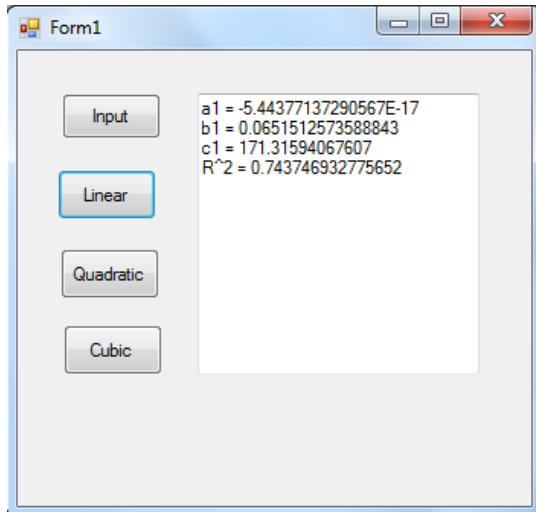
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For some topographic analyses, such as computation of random roughness and semivariograms, the overall slope of a surface often needs to be removed. This program is designed to remove the slope for any surface by using the linear, quadratic, or cubic plane fitting method. The user can try all the three methods and compare their coefficient of determination ( $R^2$ ) values to find the best fitting plane to remove the slope from the surface.



## 1. Methodology

Linear plane fitting method: Based on the original DEM data and the least square criterion, a linear plane is determined to best fit the original data. The linear plane can be expressed as:

$$Z = f(x, y) = ax + by + c$$

The program determines the coefficients  $a$ ,  $b$ , and  $c$ , as well as  $R^2$  according to the original DEM and the fitted plane.

Quadratic plane fitting method: The quadratic plane can be expressed as:

$$Z = f(x, y) = a_1x^2 + a_2xy + a_3y^2 + a_4x + a_5y + a_6$$

Similar to the linear plane fitting method, the six coefficients ( $a_1 - a_6$ ) and  $R^2$  are determined.

Cubic plane fitting method: The cubic plane can be expressed as:

$$Z = f(x, y) = a_1x^3 + a_2y^3 + a_3x^2y + a_4xy^2 + a_5x^2 + a_6y^2 + a_7xy + a_8x + a_9y + a_{10}$$

Similar to the linear and quadratic plane fitting methods, the ten coefficients ( $a_1 - a_{10}$ ) and  $R^2$  are determined.

By comparing the  $R^2$  values from the three methods, the best method with the highest  $R^2$  value can be identified. It provides the best fitting plane to the original DEM data and the most effective way to remove the overall slope of the surface. In the program, the surface slope is removed by subtracting the elevation values of the fitted plane from the corresponding values of the original DEM for all data points.

## **2. Procedure**

- 1) Input Data: By clicking the button “Input,” users can load the surface DEM data. The data should include three columns in the order of x, y, and z.
- 2) Surface Slope Removal: Users can perform surface slope removal by clicking any of the three buttons “Linear,” “Quadratic,” and “Cubic.” After slope removal, the coefficients of the best fitting plane equation and the  $R^2$  value for the selected method are displayed in the textbox. In the meantime, the new surface data after slope removal are saved to the file “linear remove.txt,” “quadratic remove.txt,” or “cubic remove.txt” in the same working directory as the one of the original DEM data.