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Automatic extraction of slope failures based on topographic characteristics in high accurate DEM using slit method

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Analytical studies on topographic and geologic conditions of the locations, where slope failures occurred, have been made for construction of a large-scale slope hazard map by some researchers. In these cases, whereas topographic information can be easily obtained from DEM, the location of the occurrence of slope failures cannot be obtained from such data, and air photo interpretation is necessary for the latter by specialists. However, if we use high accurate DEM and establish any analytical methods, it may become possible to obtain the information of slope failures also by the analyses of DEM. Because pulse of airborne laser scanner reaches ground surface through vegetation. When a specialist extracts slope failures by air photo interpretation, he use concave topography or topographic discontinuity such as scarplets in mountain slopes as fundamental information. Therefore, if we could distinguish them by numerical calculation of topographic data in DEM, it may become possible to extract them automatically.

Here, slit method, which is well known as one of image analysis methods, was applied to obtains characteristic topography of slope failures. The method is effective for the case that shape does not change with time. To obtain the topographic discontinuity, laplacian values, the second derivative of topography are used. As an attempt, 2m-mesh DEM of Misumi area, Shimane, Japan was used. This analytical procedure is as follows.

At the first step, based on DEM and a threshold value Lt, some probable points $(i,j)$for centers of concave topography indicating old slope failures can be obtained by analyses of DEM. In a circle with radius R, laplacian value $L(D,R)$ can be determined by rotating a slit with radius R around the point (i,j). Plotting the laplacian value on the space of D and R, the distribution of values $L(D,R)$ shows the characteristics of topography around it. Based on this distribution, it may possible to judge that the point is a center of failure or not, and to estimate the configuration of failures in the cases that slope failures topography was confirmed.

Consequently, many concave topography indicating small-scale failures were extracted automatically. Most of smaller ones cannot be extracted by air photo interpretation. Various scales concave topography indicating failures in different scales may also extracted by using different parameter in the analysis. Extracted portions obtained here is only concave portions topographically, and some of them are not coincide with the slope failures extracted from air photo interpretations. Shapes of slope failures in larger-scale mainly extracted from air photo interpretation may be more complicated, and may be different from that of smaller ones extracted by this method.