STUDY ON ROAD DAMAGE ASSESSMENT BASED ON RS AND GIS *

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ABSTRACT

After the occurrence of natural disasters, objective and accurate assessment of road damage is the key to emergency rescue. However, in the traditional road damage assessment, the assessment factor and the form of assessment result are single (Chen Shirong, Ma Haijian etc. 2008, Liu Yalan, Zhang Yong etc. 2008), and only the damage rate of road (the ratio of damage length to total length of the road) is used to determine the damage level of this road. It can only give an overview of the damage roads after a disaster, but can't further provide the traffic capacities of the post-disaster roads and the detailed information of damage blocks of each road, which are essential for the disaster relief department. A new approach of road damage assessment is presented in this paper. The damage levels are graded based on the magnitude of post-disaster traffic capacities of the roads, and the detailed damage information is output at three levels—damage block level, single-road level and region level. The general assessment process is illustrated in Figure 1.

1. Road damage detection

The damaged region is detected from the remote sensing images of post-disaster roads (Haijian Ma, 2008), and then the distribution of road damage is acquired, which is shown in Figure 2. In order to facilitate the calculation of damage assessment factors in the next step, the damaged region of road is divided into a few damage blocks.

2. Damage assessment

Assessment model

According to the definition of the traffic capacity of road (Highway Capacity Manual, 2004), we summarize five impact factors of actual traffic capacity of road and take them as the damage assessment factors, including: total length rate of damage, total area rate of damage, average width rate of damage, the

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number of damage blocks, the number of complete damage blocks. In addition, based on the above factors, we develop a grading rule of road damage degree, which gives the value extent of each index at the corresponding damage level. The values of different assessment factors of the same road probably belong to different damage levels and it's difficult to grade the damage degree with the human judgement. Considering this problem, a damage assessment model is established based on the method of grey cluster analysis (Julong Deng, 1990), to grade the damage degree of road.

Assessment process

First, the values of damage assessment factors are calculated from the geometric attribution of damage blocks of the road. Second, the factor values are normalized into the same dimension and the weights of each factor to different levels are calculated. Then, the membership degree to every damage level can be obtained. At last, the damage levels of all roads are determined by the membership degree matrixes.

3. Output of assessment results

According to some practical needs of the disaster relief action and post-disaster reconstruction, this paper outputs the damage statistics information at three levels—damage block level, single-road level and region level. At damage block level, it includes the coordinates of start point and end point, length, width, area and damage type of all damage blocks of each road, which provide essential data for emergency restoration of damaged roads and the post-disaster reconstruction. At single-road level, it includes the damage statistics information and the geometric attribution of road. At region level, it outputs the damage statistics chart of roads in a region. In addition, it also outputs the damage level picture with graduated colors (Figure 3).

Finally, we apply this method to the assessment of national highways of Wenchuan county in Wenchuan earthquake. The experimental result shows the validity of this method.

Key words: Road damage assessment; Remote sensing; Earthquake damage evaluation

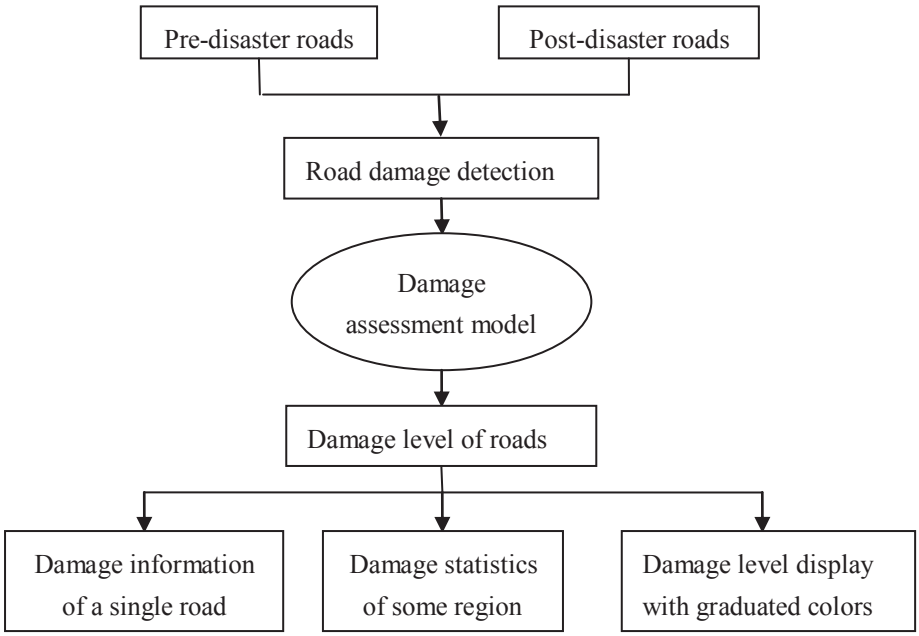

Figure 1. Flow chart of general assessment process

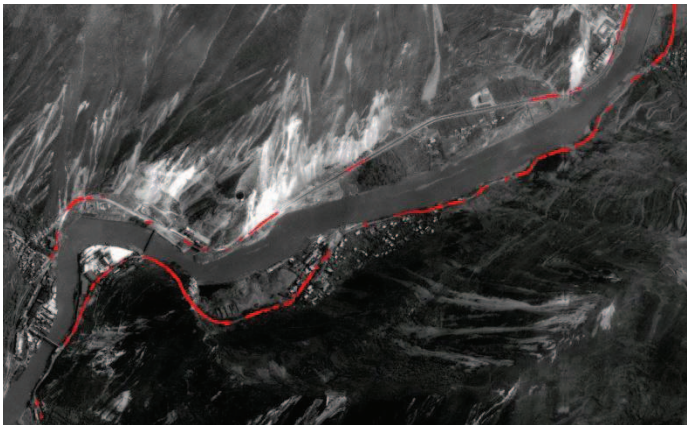

Figure 2. The damaged region of road

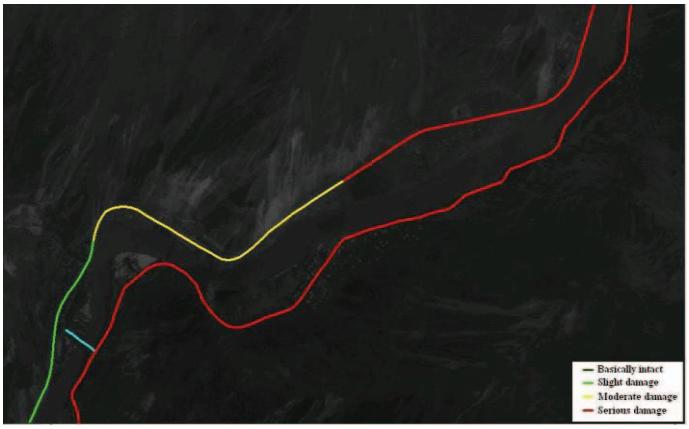

Figure 3. The damage level picture with graduated colors

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