Estimation Method of Roof-injured Buildings from Aero Photo Images using Deep Learning in Earthquake Disaster

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Abstract

After earthquake disaster happened, local governments want to grasp entire damage to issue disaster certificate smoothly. This disaster certificate is issued after investigating house damage and decide contents of victim's support corresponding the house damage. However, issuing the disaster certificate have took a long time in earthquake disaster so far. As a result, victim's support was delayed. So local governments need more efficient issuing disaster certificate mechanism.

Japanese government revised manual of issuing disaster certificate and investigating house damage many times after earthquake disaster. After The 2016 Kumamoto Earthquake, Japanese government revised these manuals and enable local governments to investigate house damage by using aerial photo only when the house is damaged seriously. This means that Japanese government recommend using aerial photo to make investigating house damage more efficient and rapid.

And accuracy of image recognition using DCNN (Deep Convolutional Neural Network) is improving remarkably in recent years. It is said that DCNN's discrimination power become stronger than human. From the above, this study's object is to make investigating house damage more efficient and rapid by using aerial photo and image recognition (DCNN). We will specify houses whose roof is damaged by using aerial photo and DCNN. Then government will grasp approximately how many houses is damaged and what regions have many damage houses. So, they can predict time it takes and necessary number of investigators, instruments and working place. Consequently, investigating house damage and issuing damage certificate will be efficient and rapid.

We use location information of building polygon on GIS to make roof image database which is necessary for DCNN. Trimming algorithm automatically cuts out building (roof) part from aerial map by using the location information. This algorithm leads to higher accuracy of image recognition and more reduction of time to make roof image database than manual way.

We try to make two DCNN models to specify damaging roof directly and roof covered with blue sheet. Accuracy of specifying roof covered with blue sheet is 95.05% but accuracy of directly specifying damaging roof is 76.10%. Low image quality and few images of learning database may cause this low accuracy.

To enable the specifying system to operate in actual earthquake disaster, we should revise image database and DCNN model taking image data which DCNN mistook into consideration. Then we should make the system have higher accuracy.