Automated Damage Evaluation for Big Visual Data Collected from Earthquake

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SUMMARY

In this study, a novel and powerful method for post-disaster evaluation is proposed by processing and analyzing big visual data in an autonomous manner. Recent convolutional neural network algorithms are implemented to automatically extract the visual content of interest from the collected images. Image classification is incorporated into the procedures to achieve accurate extraction of target contents of interest. As an illustration of the technique and its capabilities, collapse classification in concrete structures is demonstrated using a large volume of images gathered from past earthquake disasters.

Keywords: Post-disaster evaluation, Big data, Convolutional neural networks,

I. MOTIVATION

During a natural disaster, vast amounts of perishable visual data are collected formally by teams of experts that generate new knowledge by learning from that event. However, there is a huge gap between the potential of using such visual data for actual research. Due to the enormous amount of time required, only a small portion of the images collected are accessible to the public and are archived. A pressing challenge is to establish suitable methods to handle large-scale unstructured visual data to be tractable automatically.

To distil such information in an efficient manner, we develop a novel method for the automatic classification of post-disaster images collected. An enabling factor in the proposed method is that we exploit convolutional neural network algorithm implemented for image classification.

II. TECHNICAL APPROACH AND RESULTS

We target a specific application to demonstrate the technique, to classify images of collapsed buildings and building components. Our definition of “collapse” for purposes of this study includes images that show buildings or building components that have lost their original shapes or produce a large amount of debris.

All images used for this demonstration are manually labeled from our image database. Our dataset is composed of 1,850 collapse images as positive and 3,420 non-collapse images as negative, for a total of 5,270 images. All labeled images are divided into 2,636 (50%), 1,317 (25%), and 1,317 (25%) images for training, validating and testing.

We obtain rates of 90.26% (417/462 images) true-positive (true classification of collapse images) and 92.16% (788/855 images) true-negative. The precision is 0.862, defined as the number of true-positives over the number of positives. Random samples of testing results with their predicted labels are shown in Figure 1.

Figure 1. collapse classification results. Note that text labels indicate classification results and green and red colors are true and false estimation.

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REFERENCES

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