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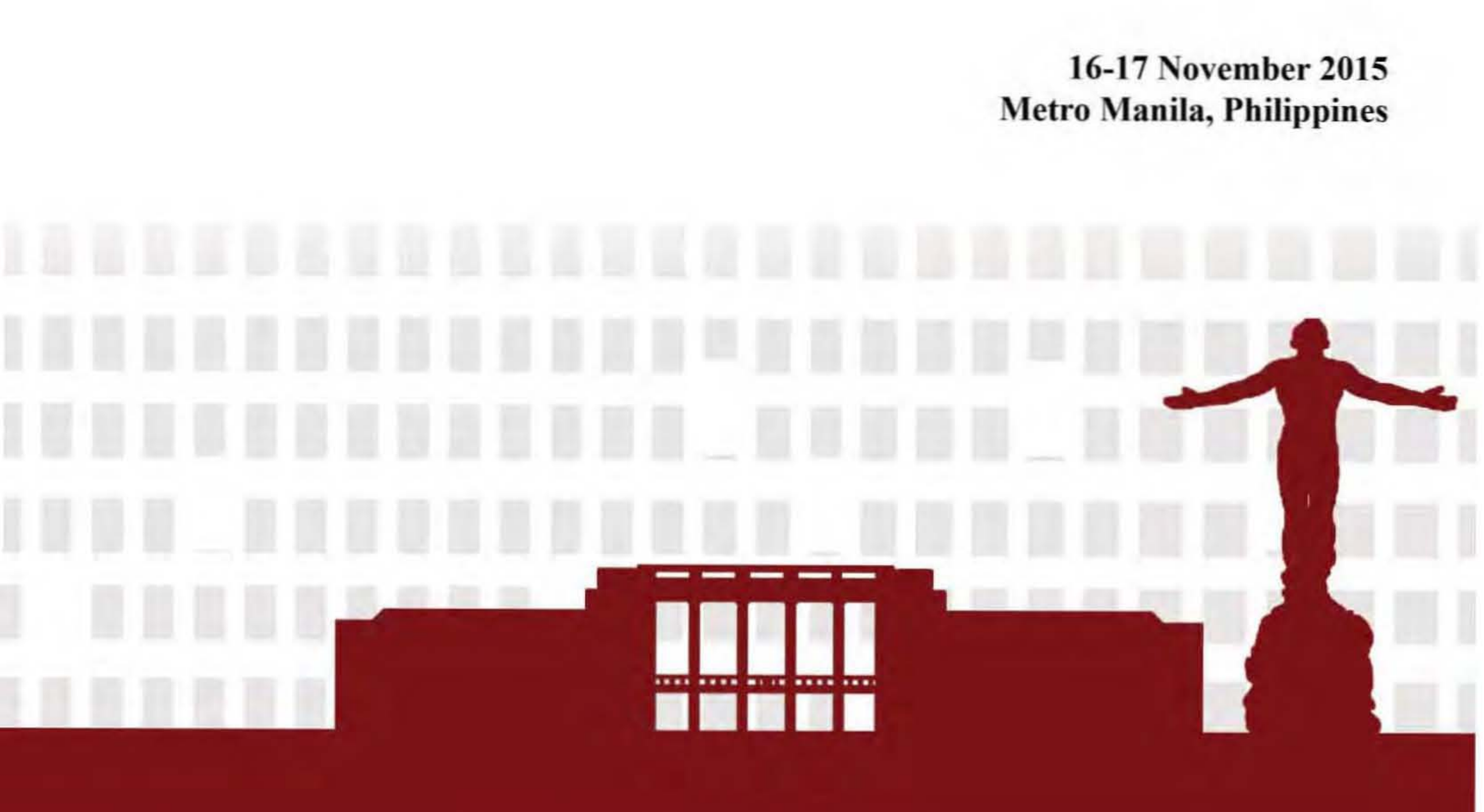
on Semiconductor and Electronics, Information and Communications Technology and Energy

16-17 November 2015
Metro Manila, Philippines



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AUTOMATED FEATURE EXTRACTION OF PRE-PROCESSED SATELLITE IMAGES FOR POST-DISASTER DAMAGE IDENTIFICATION

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ABSTRACT

In this project, image processing algorithms were designed and developed to perform feature extraction on satellite images in order to provide fast and efficient damage assessment. This project focused on Tacloban before and after Typhoon Yolanda (Haiyan) as the site of study and made use of 2 (one before and one after Yolanda) input satellite images with no obstructive weather activity.

Before actual image processing algorithm, all significant buildings were manually tagged to establish the ground truth required to assess the performance of the building and damage detection algorithms that were used in the project. The precision and recall metrics were used for algorithm evaluation.

The 2 input satellite image data then underwent some pre-processing steps. Manual cropping was implemented to align the 2 input images. Contrast enhancement, color balance adjustment, and bilateral filtering were used to enhance the edges and corners and reduce the noise and pixelation of the input images. Aside from the aforementioned reasons, pre-processing steps were also implemented to make sure that the input pre-disaster and post-disaster satellite images are more or less the same as seen in Figure 1.

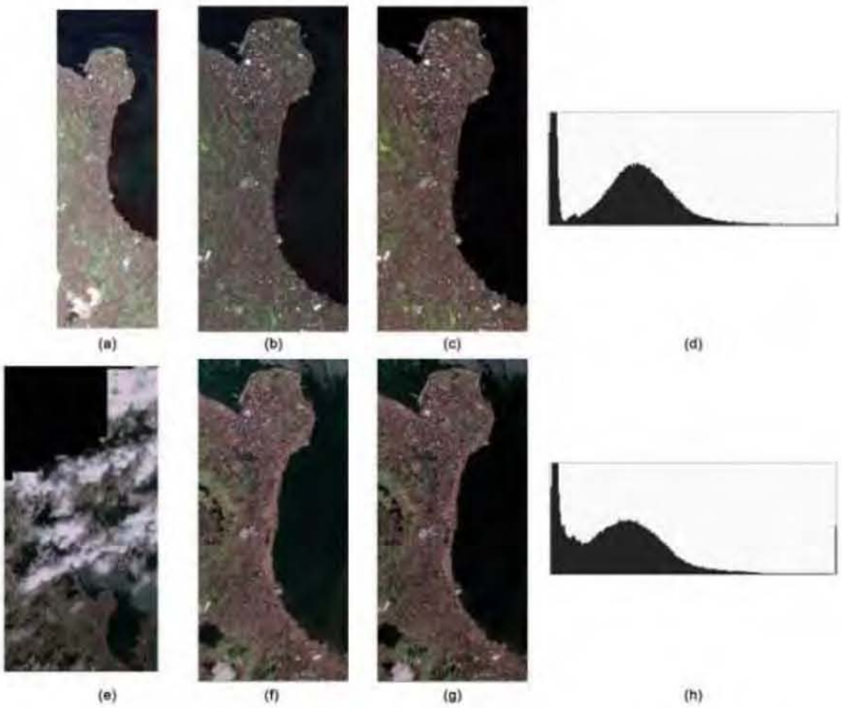

Figure 1. (a-d) Pre-disaster Image Pre-processing (e-h) Post-disaster Image Pre-processing. (First Colum) Original Image Data (Second Column) Alignment Results (Third Column) Contrast Enhancement and Color Balance (Fourth Column) Histograms of output images

In order to detect structural building contours automatically, multiple segmentation techniques were used, namely: Canny Edge Detector, Baglodi's Edge Detector, and Line Segment Detector (LSD). The resulting binary images will then undergo several morphological operations in order to connect gaps in building borders, remove stray pixels, and other adjustments that were needed to be able to produce a significant mapping of every detected building in both the pre-disaster and post-disaster images.

After successful segmentation, building-pairs were generated from the output binary images of the pre- and post-disaster data. This was done by using the centroids of each pre-disaster building segment and matches it with the nearest post-disaster building segment that is within a predetermined window. This will serve as the compensation for the misaligned building rooftops.

To be able to detect if a building was damaged or not, a comparison between the properties of each building-pair was done. The *area* and *orientation* properties between the pre- and post-disaster images were extracted and analyzed. A building will be tagged as damaged if it exceeds the threshold set and undamaged if not.
Then the data will be tabulated and analyzed. For the building segmentation stage, the Baglodi edge detector was the one with the highest recall but with it also being the highest with false positives, LSD was the more preferred algorithm since it was the one with the highest precision. The only negative for LSD in the building segmentation was its high number of false negatives which can be primarily due to the line-linking criteria used. For the damage detection stage, the Canny edge detector was the one with the highest recall but the LSD was also the one with the highest precision.

Based on the results, the LSD had the highest precision in both the building segmentation (an average of 63.44%) and damage detection (80.77%) stages.

Keywords: Building Segmentation, Damage Detection, Satellite Images

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