Building Inventory and Damage Detection By Satellite Image Processing

Group 04 – SATREPS Project

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Building Damage Estimation Flow

- Strong Ground Motion (G1)
- Damage/Loss Function (G3)
- Damage/Loss Probability
- Building Inventory
- Number of Households
- Total Damage/Loss of Households
Estimation of Household Numbers for Large Area in Lima City

Dataset
- INDECI Data
- Satellite Data
- INEI Census
- CISMID Data
- Field Survey

Number of Households in Manzana

Adobe etc.
- Individual House, Quinta, Callejon, Temporary House

Masonry, Cement Brick
- Individual House, Quinta, Callejon
- Apartment

Social Class

Number of Households for Each Building Type

Overview of ALOS/PRISM

Data acquisition model

3D Model Generation

Swath width 35km
Backward
Nadir
Forward

3D Model

Pointing Coverage 70km
Sub-satellite track
ALOS/PRISM Image and DSM

Acquisition date: Oct. 15, 2008
Spatial resolution: 5 m

Ortho-rectified Image

DSM (Digital Surface Model)

PRISM DSM in Downtown Lima
Estimated Building Height from PRISM DSM
- Comparison with Field Survey Data -

About half of the buildings have been successfully assessed with an error equal to or less than 10 m.

Estimated Building Height at Lot in City Block Using PRISM DSM
Vulnerability Assessment of Settlements on Hilly Area – Identification of Blocks with high slope – High Risk –

Built-up Age Estimation from Time-series Satellite Images

Landsat/TM: Spatial Resolution = 30 m, Band 1～7 (Visible～Near Infrared～Thermal)
Vegetation Change

NDVI (Normalized Difference Vegetation Index)

\[
NDVI = \frac{B4 - B3}{B4 + B3} \quad (-1 \leq NDVI \leq 1)
\]

High NDVI areas (vegetated areas) are decreased especially in the northern and eastern part of the city.

(Vegetated area ➔ Built-up area)

Urban Change

NUI (Normalized Urban Index)

\[
NUI = B3 + B6 - B4 - B5 \quad Bn = \frac{Bn - \text{Ave}_{Bn}}{SD_{Bn}} \times 50 + 100 \quad (n = 3, 4, 5, 6)
\]

High NUI areas (bare ground areas) are decreased especially in the northern part of the city.

(Bare ground area ➔ Built-up area)
Newly developed build-up areas are estimated by using difference of NDVI and NUI among images.

About 70% of built-up area had been developed before 1987.

New built-up areas sprawl to northern, southern and eastern Lima.
Synthetic Aperture Radar (SAR) Observation for Earthquake Damage Detection

ALOS/PALSAR Images
(a) 2007/7/12 [before Earthq.]  (b) 2007/8/27 [after Earthq.]

Schematic Figure of Backscattering Characteristics of Buildings

Ground Survey Data
(a) Damage map by CISMID
(b) Severe damage ratio distribution
Damage Estimation Using Integration of SAR Image and Seismic Intensity Data

Zrj vs Normalized Likelihood Function

Seismic Intensity vs Fragility Function

Damage Rate based on Integration of SAR and Seismic Intensity

(a) Mean

(b) standard deviation

Estimated Damage and Comparison with Field Survey Data

Severe damage ratio estimation using SAR and Seismic Intensity

Severe damage ratio distribution calculated from CISMID data
MUCHAS GRACIAS.