The Christchurch Aerial Semantic Dataset

Bertrand Le Saux, Hicham Randrianarivo, Nicolas Audebert *
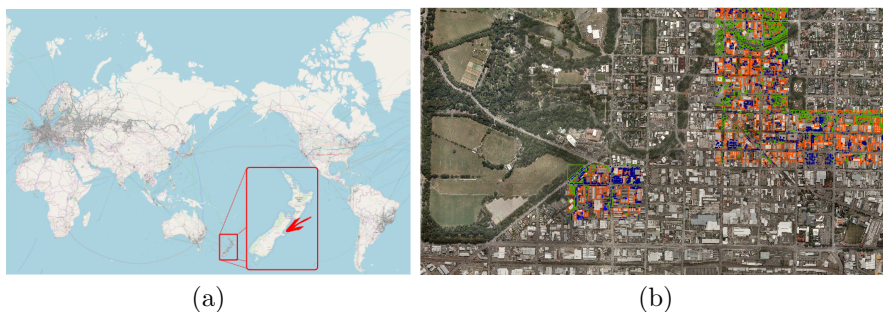
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1 Overview

Figure 1: Overview of the Christchurch Aerial Semantic Dataset. (a) Location of Christchurch on the World map (OpenStreetMap: © OpenStreetMap contributors). (b) Very-high-resolution imagery with superimposed annotated areas in colors.

The Christchurch Aerial Semantic Dataset (CASD) comprises aerial imagery at very high resolution over Christchurch, New-Zealand, and reference semantic data for urban objects such as buildings, vegetation and vehicles (see Figure 1).

Download from: `https://zenodo.org/record/3566005`

It aims to foster research in various topics of Earth observation and computer vision, including:

- image classification, or semantic segmentation: aerial imagery with semantic maps are provided in order to develop and evaluate algorithms;

- object detection: more than four thousands objects are provided in order to promote Object-Based Image Analysis;

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*B. Le Saux is with DTIS, ONERA, Université Paris-Saclay, FR-91123 Palaiseau, France, web: `https://blesaux.github.io`, email: `bls@ieee.org`; H. Randrianarivo is now with Qwant Research; N. Audebert is now with CNAM ParisTech, email: `nicolas.audebert@cnam.fr`.

- urban analysis: very-high resolution imagery on a town center is distributed to find ne wways to study urban areas;

- semi-supervised learning: in addition to labeled areas, large volumes of imagery come up to extract image and urban statistics useful for classification.

2   The data

Aerial imagery consists in the *Christchurch Earthquake Imagery* dataset. It has been captured on 24 February 2011, over the area affected by the earthquake that struck Christchurch, NZ, two days before, on 22 February 2011.

It was released by Land Information New Zealand (on behalf of the Crown, on the authority of the Civil Defence National Controller). See websites below for more information:

- `https://www.linz.govt.nz/land/maps/linz-topographic-maps/imagery-orthophotos/christchurch-earthquake-imagery`

- `https://data.linz.govt.nz/layer/51932-christchurch-post-earthquake-01m-urban-aerial-photos-24-february-2011/`

The image dataset was produced by New Zealand Aerial Mapping Limited (NZAM, `http://nzam.com/`) at the request of the Christchurch Response Centre to support the response to the earthquake.

Images are standard Red-Green-Blue photographies. They are orthorectified with respect to an existing digital terrain model and have a ground-sampling distance of 10cm/pixel. Images may vary in size, but dimensions are roughly 5000×4000 pixels per image.

Annotations were produced by ONERA/DTIS (`https://www.onera.fr/en/dtis/research-units#iva`) on 4 images. Three classes were tagged: *buildings* (797 objects), *cars* (2357 objects), and *vegetation* (938 objects). All objects are given a polygonal bounding boxes. These annotations aim towards object-based detection and object-base image analysis. Indeed, each building is outlined, even if contiguous to another one.

These vector annotations were notably used for object detection using Deformable Part Models (DPM) in [3] and vehicle detection using Discriminatively-trained Mixture Models (DtMM) [2].

Moreover, rasterized versions have been produced in order to provide the user with image masks similar to those used for many semantic segmentation tasks. Additionally to previous classes, a *Background* class is added.

These raster annotations were notably used for the *segment-before-detect* approach with convolutional neural networks proposed in [1].

Both types of annotations are shown for a tile of the dataset in figure 2.

The archive we redistribute contains 24 images, named *1-000X-000Y.tif*, with $X \in \{1; 6\}, Y \in \{1; 4\}$. 20 of which remain unlabeled while 4 have annotations. Among the labeled images, a standard split is defined for training and testing algorithms [1]. Training images are *1-0005-0003.tif, 1-0005-0004.tif, and*

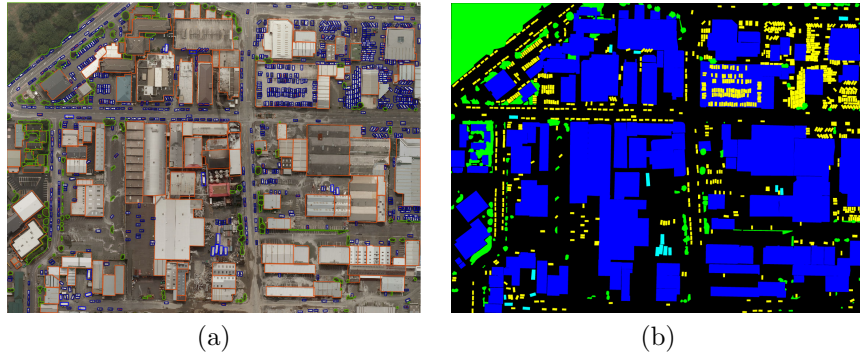|	
(a)	(b)

Figure 2: The Christchurch Aerial Semantic Dataset comes with two flavours of annotations. (a) Object-based annotations as vector shapefiles which contain bounding polygons. (b) Raster-based annotations as semantic masks (black is background, blue is for buildings, green for vegetation, and yellow/cyan for vehicles).

1-0006-0003.tif (*1-0005-0004.tif* being the validation image if needed [2]). The test image is *1-0003-0002.tif* which corresponds to an area sligthly distant from the three other ones to prevent overlapping.

3 License

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This means anyone is free to copy, distribute, and adapt the imagery so long as it is attributed to the Crown, eg "Crown Copyright Reserved."

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For research papers, acknowledgments can be done by citing the authors' works.

- H. Randrianarivo, B. Le Saux, and M. Ferecatu. Man-made structure detection with deformable part-based models. In *IEEE Int. Geoscience and Remote Sensing Symposium (IGARSS)*, Melbourne, Australia, July 2013

- N. Audebert, B. Le Saux, and S. Lefèvre. Segment-before-Detect: Vehicle Detection and Classification through Semantic Segmentation of Aerial Images. *Remote Sensing*, 9(4):1–18, April 2017

4 Download

The data archive is available for download from `https://zenodo.org/record/3566005`.

The data archive contains 24 images from the the *Christchurch Earthquake Imagery* dataset, located in downtown Christchurch, named *1-000X-000Y.tif*.

It also comprises 4 folders with reference data for 4 out of the 24 images named *1-000X-000Y/*. Each folder contains:

```
1−000X−000Y_buildings.shp
1−000X−000Y_cars.shp
1−000X−000Y_gt.tif
1−000X−000Y_npgt.tif
1−000X−000Y_vegetation.shp
```

.shp files are shapefiles wih polygons of each class defined (buildings, cars, vegetation). 1−000X−000Y_gt.tif is a color semantic mask of all classes and background. 1−000X−000Y_npgt.tif is a semantic mask with values from 0 to 3, corresponding to each of the previous classes.

Acknowledgments

References

[1] N. Audebert, B. Le Saux, and S. Lefèvre. Segment-before-Detect: Vehicle Detection and Classification through Semantic Segmentation of Aerial Images. *Remote Sensing*, 9(4):1–18, April 2017.

[2] H. Randrianarivo, B. Le Saux, M. Crucianu, and M. Ferecatu. Discriminatively-trained model mixture for object detection in aerial images. In *ESA Image Info. Mining (IIM)*, Bucarest, Romania, 2015.

[3] H. Randrianarivo, B. Le Saux, and M. Ferecatu. Man-made structure detection with deformable part-based models. In *IEEE Int. Geoscience and Remote Sensing Symposium (IGARSS)*, Melbourne, Australia, July 2013.