BUILDING CHANGE DETECTION USING CNN MODEL ON AERIAL IMAGES: A COMPARATIVE ANALYSIS OF 2012 AND 2016 DATASETS

Jingheng Huan Luyao Wang Fanbin Xu

MOTIVATION

1. Importance of detecting changes in built environment for urban planning
2. Facilitate data-driven decision-making for sustainable urbanization
3. Satellite image analysis: Real-time, precise, comprehensive data on urban transformation
4. Improve efficiency of urban planning processes

https://snworksceo.imgix.net/dtc/72f05bbe-0352-4a7a-b10e-be4fae9476f8.sized-1000x1000.jpg?w=1000

APPLICATION PROSPECTS

Urban planning: Calculate urbanization rates, monitor growth and transformation of urban structures

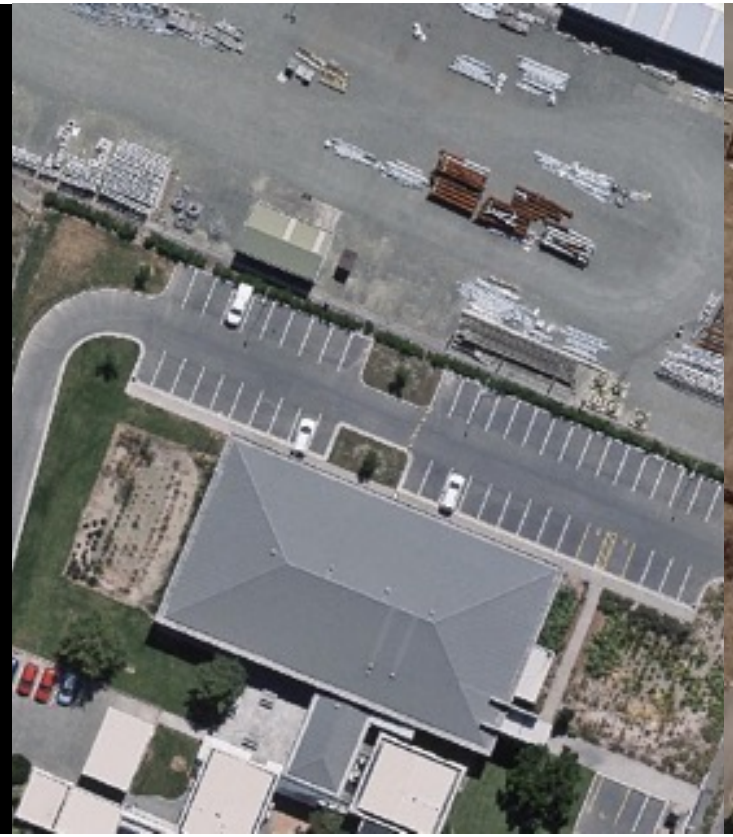
Disaster response: Detect demolished buildings, allocate resources efficiently

Environmental monitoring: Changes in lakes, glaciers, forests

DATASET

1. Aerial images taken in April 2012 and 2016
2. Covers area affected by a 6.3-magnitude earthquake in February 2011
3. 12,796 buildings in 20.5 km2 (2012) and 16,077 buildings in the same area (2016)
4. Ideal for studying urban changes in a post-disaster rebuilding context

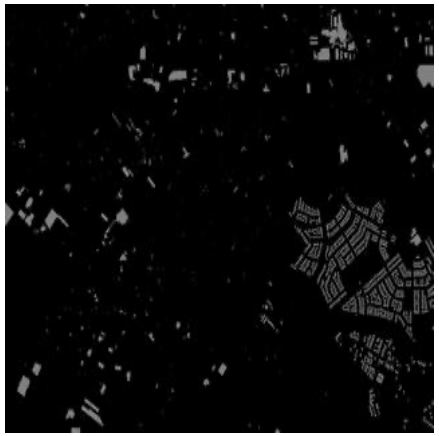
2012



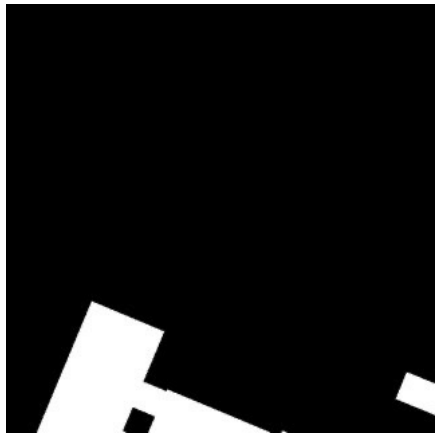
2016

https://opendatalab.com/Building_change_detection_dataset

CLEANING THE DATASET



The whole image



piece with 500X500 pixels

We manually crop the whole image to get the corresponding change label images.

DEVELOPMENT TREND

Evolution from image differencing to semantic segmentation and CNNs

Fully convolutional networks (FCNs) for pixel-wise classification

Integration of complex methodologies (e.g., Siamese neural networks, U-Net, attention mechanisms, transformers, transfer learning)

MACHINE LEARNING MODEL - SEMANTIC SEGMENTATION

Semantic segmentation based on fully connected neural network (FCN)

a computer vision task in which the goal is to categorize each pixel in an image

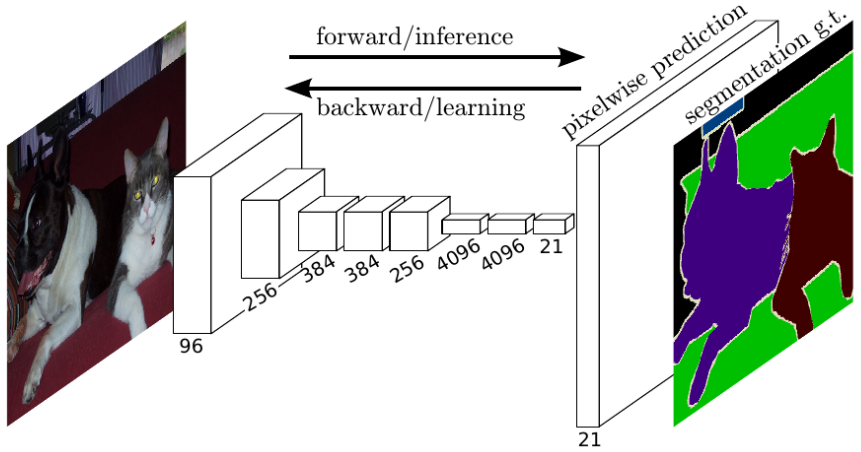
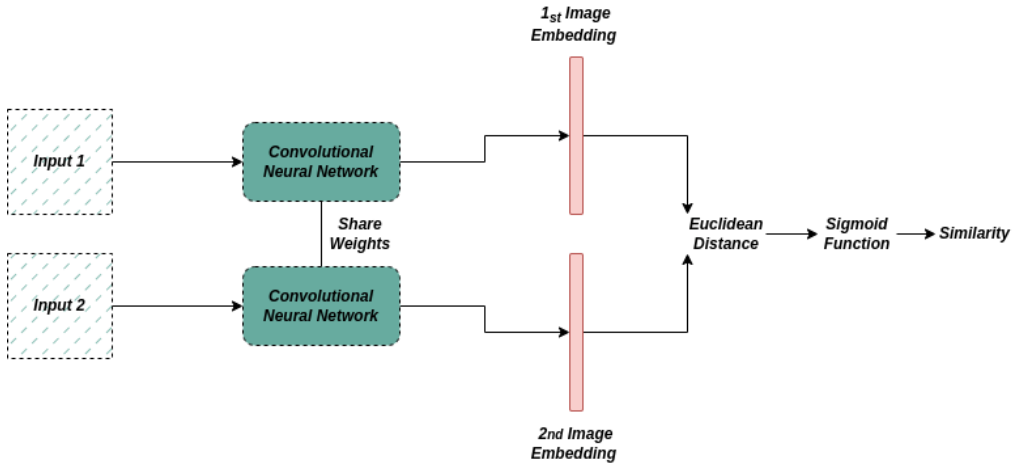


Figure 1. Fully convolutional networks can efficiently learn to make dense predictions for per-pixel tasks like semantic segmentation.

J. Long, E. Shelhamer, and T. Darrell, “Fully Convolutional Networks for Semantic Segmentation,” arXiv.org, 2014. https://arxiv.org/abs/1411.4038

MACHINE LEARNING MODEL - SIAMESE NETWORK

A Siamese neural network (sometimes called a twin neural network) is an artificial neural network that uses the **same weights** while working in tandem on two different input vectors to compute comparable output vectors.
Application: face recognition



https://www.baeldung.com/cs/siamese-networks
https://en.wikipedia.org/wiki/Siamese_neural_network

MACHINE LEARNING MODEL - SATELLITE IMAGE CHANGE DETECTION

How we combine semantic segmentation and siamese network

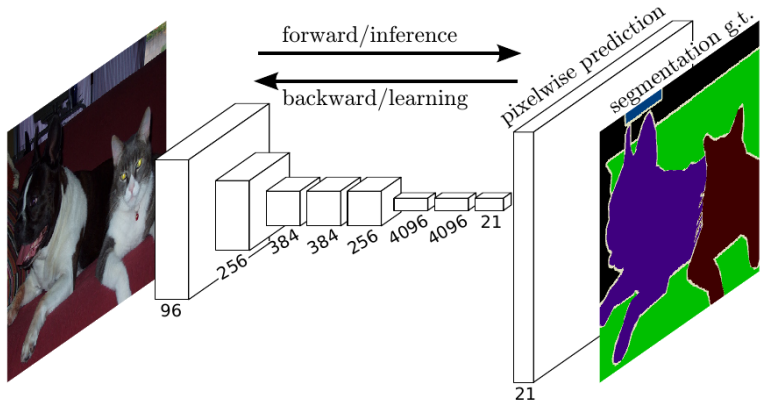
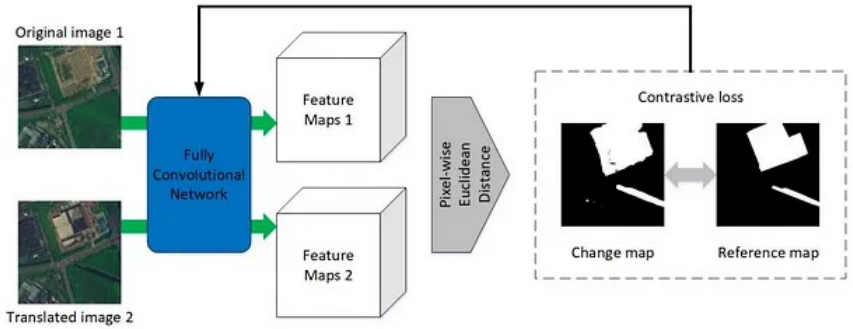


Figure 1. Fully convolutional networks can efficiently learn to make dense predictions for per-pixel tasks like semantic segmentation.



https://www.mdpi.com/2072-4292/11/11/1292

CRITICAL SCIENTIFIC PROBLEMS TO BE SOLVED

1. Minimizing false positives: To ensure the accuracy of our model, it is crucial to minimize false positives, such as misidentifying vehicles or other objects as buildings.

2. Satellite image alignment: We must develop algorithms capable of aligning images for precise comparison and quantification of changes in the built environment.

3. Scalability and adaptability: Our proposed system must be scalable and adaptable to various satellite images and time periods, ensuring its applicability across different urban environments and diverse applications.


THANK YOU