Automatic Building Detection in Wide Area Imagery

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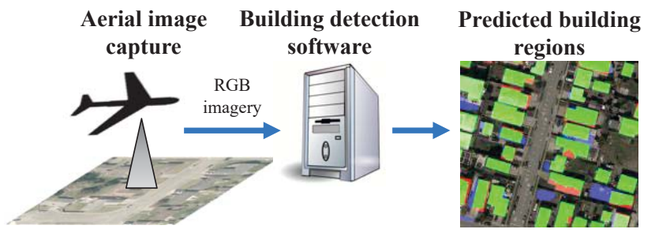
Introduction

Unauthorized construction can cause damage to public and private infrastructure, including utilities, public housing, telecommunication equipment, etc. Current construction analysis is performed by human analysts, who can become fatigued after reviewing large amounts of imagery and are expensive to employ. In order to improve efficiency and reduce cost in monitoring this unauthorized construction, there is a need for automating the detection of regions of interest in imagery.



Methodology

Many background areas can be eliminated from building candidate regions:

- Trees, grass, and other vegetation
- Shadow areas
- Long, continuous road and other ground areas

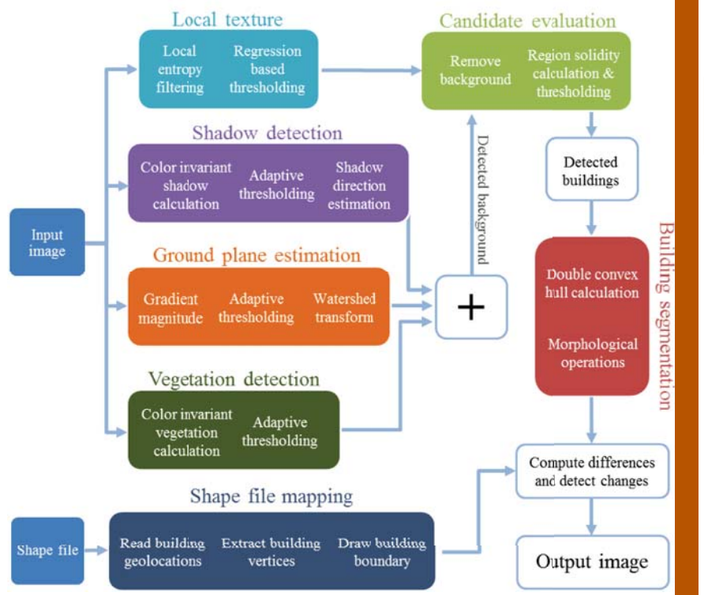
Several characteristic properties of buildings are used for their automatic detection:

- Smooth roof texture (low entropy values)
- Rectangular shape (high solidity values)
- Consistent shadow direction

The correct shadow direction of a scene can be estimated by determining the majority shadow direction of building candidates. After this direction is determined, building candidates with incorrect shadow direction can be eliminated.

Algorithm Details

Algorithm block diagram



Local entropy filtering, for texture characterization:

$$E = -\sum_{i=1}^{L} p \cdot log_2(p)$$

where p is the probability of a given pixel's intensity value in a given local region

Color invariant vegetation intensity:

$$\psi_g(i,j) = \frac{I(i,j,g)}{I(i,j,r) + I(i,j,g) + I(i,j,b)}, \forall i,j$$

Image shadow intensity:

$$\psi_s(i,j) = \frac{4}{\pi} \cdot arctan\left[\frac{I(i,j,b) - I(i,j,g)}{I(i,j,b) + I(i,j,g)}\right], \forall i,j$$

where *I(i,j,r), I(i,j,g), I(i,j,b)* are an image's red, green, and blue color channels respectively

Experimental Results

Original image scene

Building candidates with shadow direction pairing

Final detected building regions