01 Building floor count determination by Convolutional Neural Network

Description

Accurately knowing the number of floors of a building is an important factor when assessing the built environment. One objective pursued is to compare what the Zoning Plan of a municipality allows with what is currently built for an existing building. The Zoning Plan can express maximum buildable volume in different manners: maximum height in meters or maximum number of floors. In order to make a reliable comparison, it becomes important to have an accurate datapoint of "building layers" for each building, which doesn't currently exist.

An often-used approximation is by diving a total building height by an average height per floor, which result in a non-integer number of floors. We currently have run this approximation but are seeking for a refined dataset to refine our analysis methods and more accurate outcomes.

The current module would operate as part of a bigger system which complete other analysis. The module remains semi-independent as its outputs are used as inputs of other modules.

Priority

2/3

Complexity

1/3

Input

The domain of application of the module is within urban areas in the Western world. Under these conditions, one can assume that in situ image service such as Google Street View can be considered as reliable image data source.

The georeferenced images are linked to GIS file which result of a plan with a shape per building that include other unrelated parameters (such as the unique ID of the building, the date of construction, etc) In the Netherlands, this dataset is retrieved under the name BAG, standing for Basisregistratie Adressen en Gebouwen. The dataset is opensource and free of use.

There is no pre-existing training dataset in our possession. Learning transfer technique can be used to train the Deep Learning algorithm with open-source training image datasets.

- Georeferenced in situ images e.g. Google Street View (GSV) (or alternatively Open Street Cam, Baidu, Mapillary, Here, Bing Streetside, or Apple)
- Georeferenced shapefile with unique ID per building (GIS)
- Open-source training image datasets (IMG)

Output

The georeferenced GIS BAG file is enriched by a "floor amount" attribute (integer) resulting from the analysis. The date of the image used for the analysis is also reported in a separate attribute.

- Enriched georeferenced shapefile with "floor amount" attribute
- and "image date" attribute on which the analysis is based (GIS)

Reference methods

Convolutional Neural Network applied to floor amount detection - LINK
Predicted accuracy is not very high (85%) and a default is seen when assessing buildings that are higher than 4 floors tall.

02 Creation of sample dataset of construction of additional floor on top of existing building based on filtering analysis of issued building permit national public database

Description

The assessment by remote sensing of building capability to be over-build can be understood by looking at existing cases where the process has been conducted successfully. Looking, at a national level, at all instances of vertical extension can give a confidence factor of feasibility.

The creation of the sample dataset can be created by retrieving building permit applications in the national database and applying filtering parameters specifically for vertical extension of building or construction on top of an existing building.

The current module would operate as part of a bigger system which complete other analysis. The module remains semi-independent as its outputs are used as inputs of other modules. The method will be used as a first comparison dataset useful for Deep Learning methods used in other modules.

Priority

2/3

Complexity

2/3

Input

The national database of building permit can be used as a source of all addresses where a vertical extension or a construction on top of an existing building have been conducted.

The georeferenced images are linked to GIS file which result of a plan with a shape per building that include other unrelated parameters (such as the unique ID of the building, the date of construction, etc) In the Netherlands, this dataset is retrieved under the name BAG, standing for Basisregistratie Adressen en Gebouwen. The dataset is opensource and free of use.

- National register of building permit application
- Georeferenced shapefile with unique ID per building (GIS)

Output

The georeferenced GIS BAG file is enriched by the characteristics of the over-build (i.e. number of additional floors, number of additional units, construction typology, etc)

A comparison of indicative datapoints, characterizing the existing building, that are relevant to assess a “confidence factor” for the feasibility of speculative construction over other existing buildings

- Enriched georeferenced shapefile with "new construction” attributes (date of construction, number of new floors, typology, materials used)
- Comparison of the new attributes with “existing construction” attributes
- Estimation of residual structural strength of the existing building

Reference methods

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03 Assessment of Building Residual Structural Strength Using Visual and GIS datasets through Machine Learning techniques

Description

In order to know how many floors can be built on top of an existing building, different methodologies can be adopted. One methodology resides on comparing outdoor images of a building to assess with a sample dataset where additional floors have been built on top of an existing building.

Using a previously defined dataset of buildings with additional floors built on top, a set of parameters can be defined in order to assess other potential building to asses. For instance, parameters like number of floors of the existing building, the year of its construction, or its structural systems are known to be affecting factors for the potential of addition of new floors on top of an existing building.

A visual analysis (i.e. Google Street View) of the existing cases in the sample dataset, coupled with known hidden attribute layers (i.e. building age, footprint, typology, etc) available as open source, can give a pattern of parameters that can be then assessed in other speculative cases to assess a confidence factor of feasibility.

The current module would operate as part of a bigger system which complete other analysis. The module remains semi-independent as its outputs are used as inputs of other modules.

Priority

2/3

Complexity

3/3

Input

The domain of application of the module is within urban areas in the Western world. Under these conditions, one can assume that in situ image service such as Google Street View can be considered as reliable image data source.

The georeferenced images are linked to GIS file which result of a plan with a shape per building that include other unrelated parameters (such as the unique ID of the building, the date of construction, etc) In the Netherlands, this dataset is retrieved under the name BAG, standing for Basisregistratie Adressen en Gebouwen. The dataset is opensource and free of use.

The training dataset would be coming from a previously built sample dataset giving residual resistance estimation (based on analysing successfully conducted construction on top of existing buildings).

- Georeferenced in situ images e.g. Google Street View (GSV) (or alternatively Open Street Cam, Baidu, Mapillary, Here, Bing Streetside, or Apple)
- Georeferenced shapefile with unique ID per building (GIS)
- Open-source training image datasets (IMG)
- Training sample dataset

Output

The georeferenced GIS BAG file is enriched by an estimated “residual structural strength” attribute (float) resulting from the analysis, and a number of possible floors that can be added to the existing building.

- Enriched georeferenced shapefile with “residual structural strength”, “potential additional floors” attributes (GIS)
- Algorithm that can be used to visually compare (with GSV and hidden attribute layer) a speculative building

Reference methods

Multi-sensor remote sensing and Random Forests - LINK
To be assessed what is the necessary sample set size and how accurate this can become if apply to another context (other city/country)

04 Assessment of building structural strength by extrapolation of internal floor plan and building cross section in the absence of indoor measurements

Description

In order to know how many floors can be built on top of an existing building, different methodologies can be adopted. One methodology resides on extrapolating a building structural system (floor plan and cross section) with only access to outdoor images of the building and other open datasets and attributes (building construction date, footprint, height, etc).

Using a previously defined dataset of buildings with additional floors built on top, a set of parameters can be defined in order to assess other potential building to asses.

A visual analysis (i.e. Google Street View) of the existing cases in the sample dataset, coupled with known hidden attribute layers (i.e. building age, footprint, typology, etc) available as open source, can give a pattern of parameters that can be then assessed in other speculative cases to assess the structural system and its strength.

The current module would operate as part of a bigger system which complete other analysis. The module remains semi-independent as its outputs are used as inputs of other modules.

Priority

2/3

Complexity

3/3

Input

The domain of application of the module is within urban areas in the Western world. Under these conditions, one can assume that in situ image service such as Google Street View can be considered as reliable image data source.

The georeferenced images are linked to GIS file which result of a plan with a shape per building that include other unrelated parameters (such as the unique ID of the building, the date of construction, etc) In the Netherlands, this dataset is retrieved under the name BAG, standing for Basisregistratie Adressen en Gebouwen. The dataset is opensource and free of use.

- Georeferenced in situ images e.g. Google Street View (GSV) (or alternatively Open Street Cam, Baidu, Mapillary, Here, Bing Streetside, or Apple)
- Georeferenced shapefile with unique ID per building (GIS)

Output

This algorithm has to output a "residual structural strength" and a number of possible floors that can be added to the existing building. These attributes will enrich the georeferenced GIS BAG file.

- Enriched georeferenced shapefile with “residual structural strength”, “potential additional floors” attributes (GIS)

Reference methods

Constraint Propagation and Stochastic Reasoning - LINK
To be assessed the level of accuracy possible