Image Analyses and Real Estate: Evaluation of the Quality of Location Using Remotely Sensed Imagery

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Motivation

- Importance of Micro-Location in Regional Economics
- Issues in the definition of Submarkets
- Advanced methods in image analysis
- Increasing data availability nowadays
- Interdisciplinarity
Location Quality Aspects

Uniqueness of Submarket/Neighborhood/Micro-Locatıon

Property position: first, second, ...nth row from the street?
noise, green areas, view ...
Theoretical background in property valuation

Theoretical framework of real estate valuation is underpinned by the theory of hedonic prices

\[ P_i = f(C_i, S_i, N_i) \]
Theoretical background in property valuation

Approaches for the identification of Submarkets:

- Spatial
- Hybrid
- Structural
First law of geography: “Everything is related to everything else, but near things are more related than distant things” (Tobler, 1969).
Theoretical background in property valuation

Issues in the definition of Submarkets

- Problem of variability at small segments
- Modifiable areal unit problem (MAUP)
- Border relocation due to growing social and infrastructural segregation
Figure 1: Exemplary patches with selected region of interest (ROI) in the middle and surrounding micro-locations. The location quality of ROI is determined through the proportion of existing features, but also through statistical interaction with surrounded micro-locations.

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Figure 2: Exemplary sections from the Endach quarter in the town of Kufstein (left: less popular residential area; right: popular residential area).
Theoretical background in image processing

Goal: Object detection/segmentation

Major approaches:
- Object Based Image Analysis
- Deep Learning Analyses
- Pixel Based Analyses
Theoretical background in image processing

- Application area: Urban Remote Sensing
- Method: Supervised Classification and Segmentation with Deep Neural Networks

Figure 3: Annotations created with multiply polygon layers, (Author's illustration)
Methodology

Location Study:

• Survey with experts
• Regression analysis
• Test with lay persons using Conjoint Analyses
Evaluation of location quality:

Determination of quality classes

*Quality classes are input information for subsequent supervised Machine Learning step
Methodology

Image Processing:

- Data preparation
- Generation of ground truth
- Feature extraction & labeling
- Classifier training & prediction
Methodology

Location modeling and final evaluation:

Regression Analyses

\[ \log P = \alpha + C_i \beta + S_i \beta + N_i \beta + \varepsilon \]
Outlook

High scientific and economic potential in the alliance of automatic image recognition and the real estate industry
Outlook

The future applicability of the model is possible in areas where, except aerial photographs, there are no sufficient statistical information.
Thank You for Your Attention