

## **Capturing Housing Sub-Markets in Madrid from Satellite Imagery Using a Convolutional Neural Network and Unsupervised Machine Learning**

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### **Abstract**

The following paper proposes a novel and accessible machine learning approach to the segmentation of urban housing markets, a topic of ongoing methodological debate in the geographic literature (Wu and Sharma, 2012). We extract features from globally available satellite imagery using a neural network, and apply a clustering algorithm to identify sub-markets at the fine-grain, intra-urban scale in Madrid. To systematically explore scale effects on the resulting clusters, the analysis is repeated at several spatial scales by altering the size of the satellite image patches inputted into the model. We assess the resulting clusters and optimal algorithm parameters using several cluster evaluation metrics, and data from a major housing listing portal on various housing characteristics, such as house price, land use and housing supply. The paper evaluates the strengths and weakness of the method to identify urban housing sub-markets, a task which is important for planners and policy makers and is often limited by a lack of data. We conclude the approach could be useful to divide large urban housing markets, and monitor changes over time to the spatial housing market structure, particularly in data poor regions.

Wu, C. and Sharma, R., 2012. Housing submarket classification: The role of spatial contiguity. *Applied Geography*, 32(2), pp.746-756.