MODELLING THE URBANIZATION USING DATA-INTENSE METHODOLOGIES FOR SPATIAL TRANSLATIONS

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ABSTRACT

Although gradual advancements in Geo-Spatial information technologies enable us not only storing big amounts of data about cities but also processing and reproducing for the benefit of urbanism, conventional approaches of urban planning are falling short in dealing with inter-relational dynamics of urban complexity. Given the permanence of spatial and formal configurations in our cities, it is essential to develop new methods for better understanding and predicting the patterns of change. The human mind has developed highly advanced skills for sensing the environment and actions from what is observed. Pattern recognition is the study of how machines can observe the environment, learn to distinguish patterns of interest, make reasonable decisions about different categories of patterns. Learning from how the patterns are modelled in the nature, influences us and we develop algorithms to have a deeper understanding of patterns about the man-made systems. They all require different application technics, input patterns and pattern classes designed around the targeted purposes.

This study describes that automatic extraction of building footprints out of satellites and modelling their spatial settings and morphogenetic patterns can provide crucial information for diverse future urban sustainability applications, strategies and researches. The methodology employs diverse algorithms, as a hybrid algorithm to run parametric analysis on ortho-rectified satellite images to reveal and discuss about the morphogenetic dynamics of the cities in specific topics.

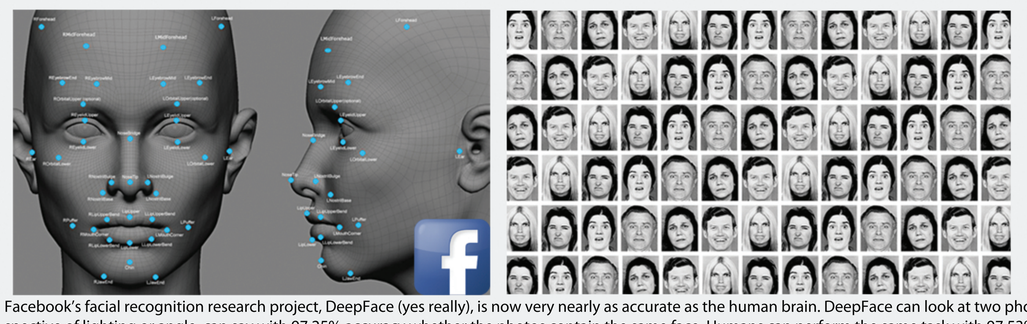
METHODOLOGY&DATA

The last few decades have seen high levels of urbanization, sprawls and uncontrollable trends of urban change in developing countries especially in Global North.

Bottom Left: Downtown Philadelphia, one from 1965 and another from 2014 (University of Oklahoma's Institute for Quality Communities). Bottom Right: Urban extent in Kanifing Municipal Area and northern Kombo North District in 1986 and 1999 from Landsat TM imagery (Columbia University).

Rapid urbanization reasoned changes on built and natural environments' sustainable urban, environmental and socio-economical co-occurrences and affected manifold issues in negative ways such as carbon foot-prints, urban heat island effects, deformation of ecosystem services and energy grids. In order to prevent this, cities need up-to-date GIS data sets with various spatial attributes to monitor and be proactive for destructive changes. However many cities are not equally well organized and institutionally - financially they do not have equal capacity in producing up-to-date and high-quality geo-spatial data.

This research offers the use of a machine learning based image understanding technology on ortho-rectified satellites to produce needed and specialized geo-spatial data to monitor the urbanization processes and trends at diverse scales in cities in the context of change.



Facebook's facial recognition research project, DeepFace (yes really), is now very nearly as accurate as the human brain. DeepFace can look at two photos, and irre spective of lighting or angle, can say with 97.25% accuracy whether the photos contain the same face. Humans can perform the same task with 97.53% accuracy (Anthony, 2014)

Recent advances on machine learning based computer skills have been acelerated with the rise of the super-fast computers. This has paved the way for numerous technological possibilities of computer-human interactions. Face recognition is one of them. One of the ways computers operate for such recognition process is a feature-extraction based recognition operation with explicit use of face knowledge -local features of the face (nose-mouth-eyes) and structural relationship between these facial features-. This type local knowledge is generally used for face localization (one face). This type computer vision technic requires good quality images that are robust to illumination conditions, occlusions and viewpoint.

METHODOLOGY&DATA

The more specialized data we produce about the city, the further we find ourselves from models or theories where they are either staying short or not helping at all. This case study employs a data-mining methodology that urban planners and designers together with data specialists can reproduce and apply for designing new models and representations adopted from parametric explorations of urban built context considering its visual-spatial data and manifold attributes.

The recognition process proposed in this research is an object-identification based feature-extraction process on high resolution satellite imagery. Object-based image analysis is also termed as vector feature extraction.

Object Identification

The biggest challenges with object categorization on a given image of complex context are (Fei-Fei, 2007):

1-Viewpoint
2-Illumination
3-Occlusion
4-Scale
5-Deformation
6-Background clutter

Thus, principally vector feature extraction on an ortho-rectified satellite image based on three major processes:

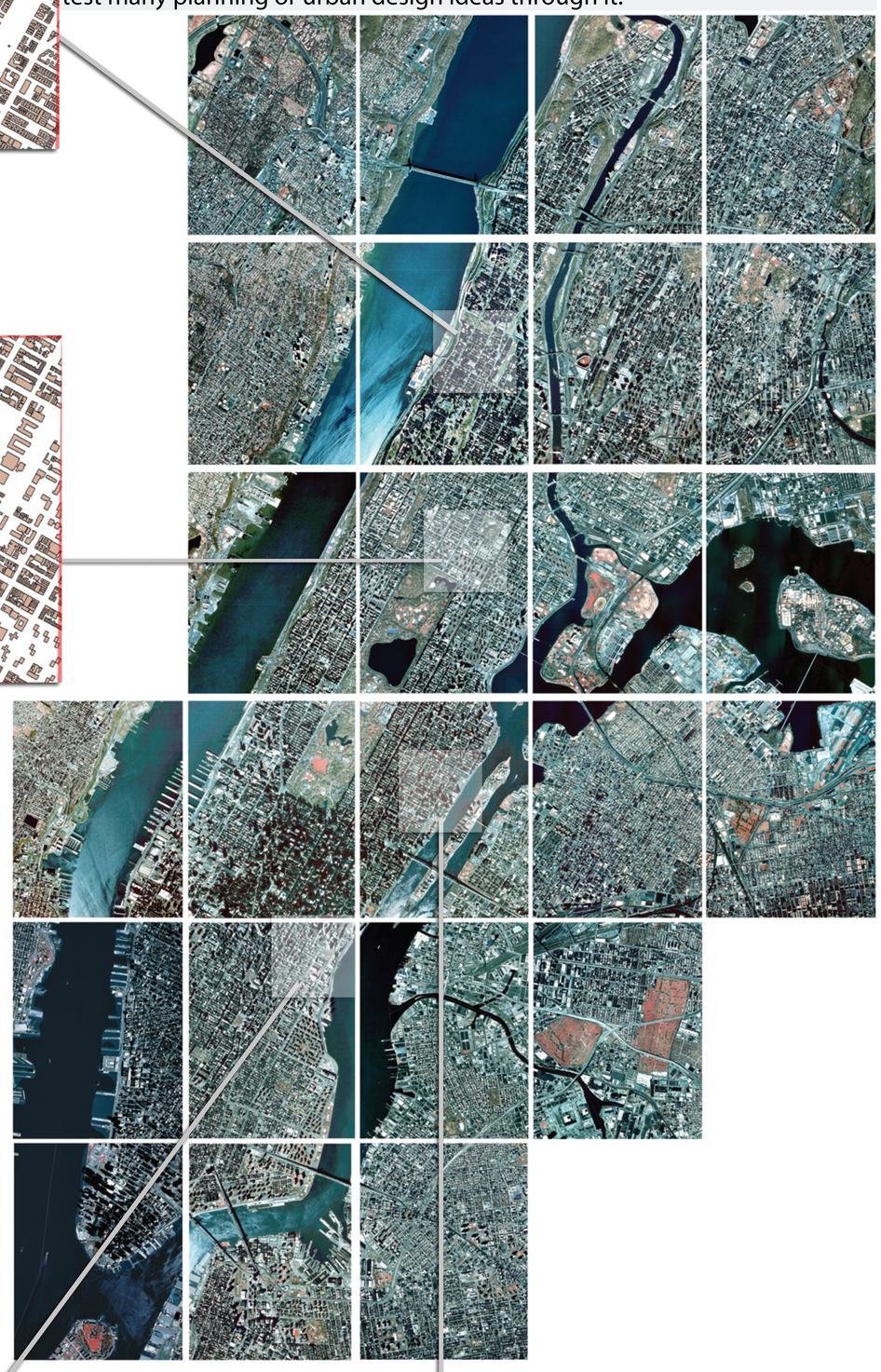
1-Representation
How to represent an object category?

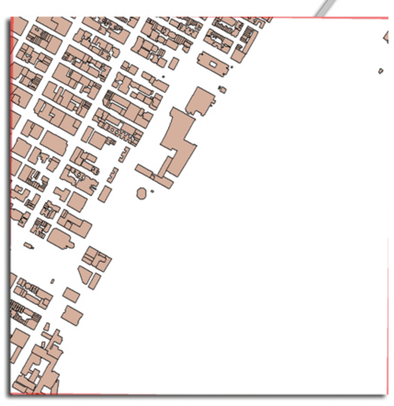
2-Learning
How to form classifier given training data ?

3-Recognition
How the classifier is to be used on a novel data?

OUTCOMES&POTENTIAL CONTRIBUTION

Cities in developing countries do not have equal financial and institutional capacity in producing up-to-date geo-spatial information. Rapid developments in image understanding technology allows us to do it. The challenge of a science of cities is to understand the links between urban morphogenesis, making of robust urban spaces and being proactive for social, environmental and economical sustainability issues on a larger scale. This type data-mining approach has a vital role in decoding the structural genomes of cities in a multi-scalar way. The training data alows us to detect manifold recombinations. Once we have the codes of urban morpho-genomes, we can test many planning or urban design ideas through it.





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