A Satellite View on Urban Dynamics

Coupled, earth observation and deep learning approaches provide an effective and efficient means of monitoring urban flows and detecting changes in urban areas near real time.

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The challenge

As city populations continue to grow and urban sprawl increases, local authorities are faced with the challenge of managing the dynamics and activities in a constantly changing environment. Data and information on urban areas are often inadequate, generalized, outdated or simply not available.

In order to measure, analyze and understand the dynamic interrelationships and permanent changes in urban landscapes, spatial information is vital. However, while existing IOT solutions, video camera surveillance and interpretation of aerial photos and satellite images provide a means to assess urban dynamics, they are resource intensive, costly and unable to provide a synoptic overview of the dynamics in entire urban landscapes. There is a fundamental need for more automatic and consistent monitoring of the dynamic flows in cities in order to inform authorities, and support their efforts to redesign smarter, greener, more sustainable and more efficient urban environments.

The space-based solution

Deep learning technology has increased the potential of satellite imagery and reshaped the way we are able to monitor activities and dynamics in urban environments.

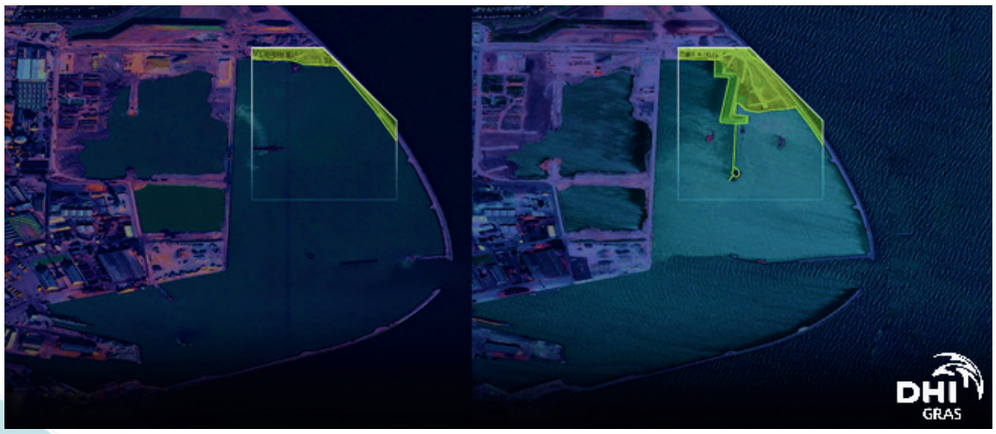
Deep learning algorithms can recognize patterns, shapes and context in imagery and use this to better map different objects of interest and thereby significantly accelerate the ability to systematically and operationally label objects and detect changes in urban landscapes.

In short, deep learning algorithms have allowed us to detect objects such as cars, tree crowns, solar panels, swimming pools, etc. with high accuracy and short turnaround for delivery, while only requiring a small amount of training data even for larger areas.

Using deep learning approaches to systematically process and label high frequent/high resolution satellite imagery (including Sentinel and Very High Resolution missions), city planners and authorities are able to tap into an indispensable resource tracking urban dynamic in near real time, allowing them to make informed management actions.

Benefits to citizens

Detailed and updated geographic information is an essential component for effective urban planning and monitoring. The use of the very high-resolution satellite imagery and deep learning algorithms offers objectivity, efficiency, and automation with regard to wide scale urban monitoring, providing



Monitoring progress of construction activities using automatic change detection on very high resolution satellite images in Køge harbor.

an efficient platform to consistently track urban dynamics and ensure up-to-date and accurate information about urban changes and movements. The added insight on urban flows and understanding about how people use urban landscapes will allow decision-makers and authorities to react faster and smarter and enable them to make informed decisions about urban policy frameworks and instruments based on actionable data and information about the structural changes and dynamics in city environments. This could support sustainable spatial development and make cities more livable, productive and inclusive.

> **“We have used satellite imagery from DHI GRAS for the routine surveys as well as follow-up and quality assurance of the construction work in the municipality. Data was easy to use and cost-effective, as well as providing good documentation for the development of the municipality’s projects.**
>
> *Steen Muchitsch, Køge Municipality*

Outlook to the future

Deep learning algorithms have only recently been adopted as an efficient approach to extract valuable data from satellite images. The technology is still in its infancy and the future will see significant advancement of deep learning approaches to leverage actionable data from earth observation data. Furthermore, technological development within spaceborne sensor systems, such as access to video from space and rapidly increasing amounts of high-resolution sensors, will further facilitate improved options for surveying city flows in near real time, potentially reducing the need for in-situ observations of traffic patterns and other relevant urban dynamics.

Tracking and monitoring cars in urban areas with very high-resolution satellite imagery and deep learning.

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