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Digital Oblique Aerial Cameras (1)

A Survey of Features and Systems



GIM International Interviews
Burak Keser

**Guiding
Museum
Visitors**

Young Geo in Focus

**Visibility
Maps of Turin**
Including Atmospheric
Conditions



The front cover shows hot-air balloons over Cappadocia, Turkey, a region famous for its unique geological features. This issue contains an interview with Burak Keser, head of the Cadastral Department in Turkey. Turkey is also hosting Intergeo Eurasia later this month (28-29 April in Istanbul).

(PHOTO: [HTTP://TRAVEL.WELLYSAFE.COM](http://travel.wellflysafe.com))

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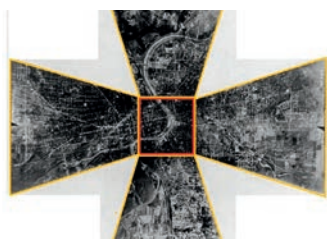
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INCLUDING ATMOSPHERIC CONDITIONS IN DSM VIEWSHED ANALYSIS

Visibility Maps of Turin

High-rise buildings affect the skyline of a city and thus the human perception of urban spaces. From which points can a building, or parts of the building, be seen? The answer requires viewshed analysis of raster or vector 3D city models. Visibility is not just a geometric exercise in which lines of sight are calculated using standard GIS tools. Visibility and perception of space are also determined by atmospheric conditions, contrast between foregrounds and backgrounds including the sky, visual acuity and psychological aspects. Here, the authors present a simple but accurate method for generating visibility maps based on the above criteria and demonstrate its effectiveness for a newly erected skyscraper in Turin, Italy.

A viewshed represents the visibility of a building or another object from a fixed vantage point and this can be computed from a digital surface model (DSM) using standard GIS functions. The result may be either 'yes' – the building is visible from the viewpoint – or 'no' – it is not visible. The results of n viewpoints within an area end up in a cumulative viewshed: $n - m$, with m being the number of points from which the building is not visible. This simple addition of the binary values 1 and 0 does not do justice to partial visibility and for this the visual magnitude has been introduced, resulting in a range of values between 0 and 1. This measure has been widely used in the analysis of rural and forest landscapes. Visual acuity is determined by the eye's visual angle and means that a building with a diameter of 20m can be seen from a maximum distance of 69km assuming crisp air, i.e. haze,

dust or other diffusing particles are absent.

METHOD

However, diffusing particles will be often present in the atmosphere and they will obstruct a clear view of the building when observed from long distances. Perfectly clear air is the best-case scenario but leads to unrealistic values as atmospheric

conditions affect visibility more than visual acuity. Visibility can be indicated from parameters that describe the atmospheric conditions, but it is more feasible to use sight distances registered over time by weather stations. The sight distances should preferably be collected hourly, and such high-frequency observations can be obtained from international databases. ▶



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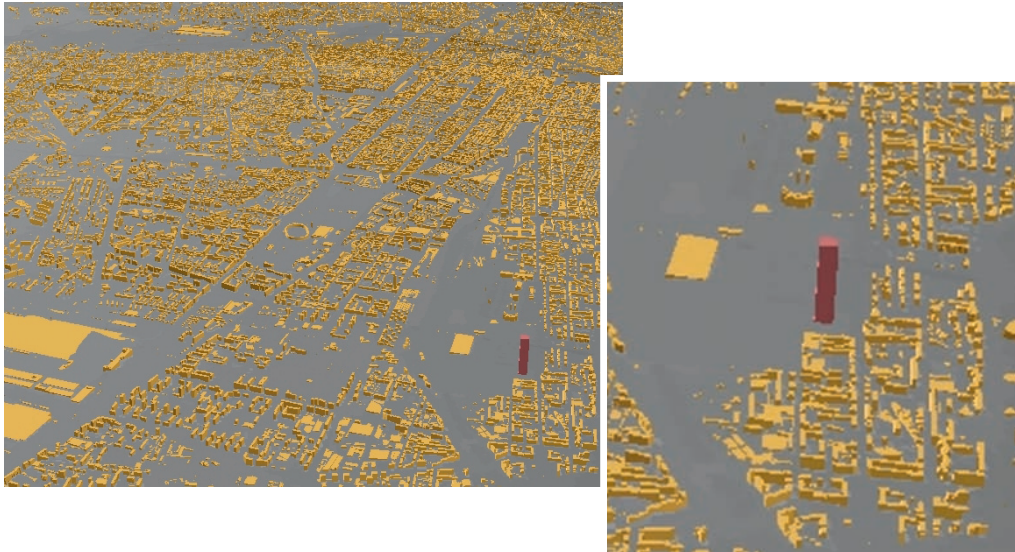
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► Figure 1, 3D raster block model of Turin (left) and skyscraper and vicinity.



Real-time weather observations can also be used. Depending on the frequency of sight changes, the sight

a lot of heavy industry, has lowest visibility in September and October, and highest in August and January;

most dominant visibility distance in a certain time span.

Perfectly clear air is the best-case scenario but atmospheric conditions affect visibility more than visual acuity

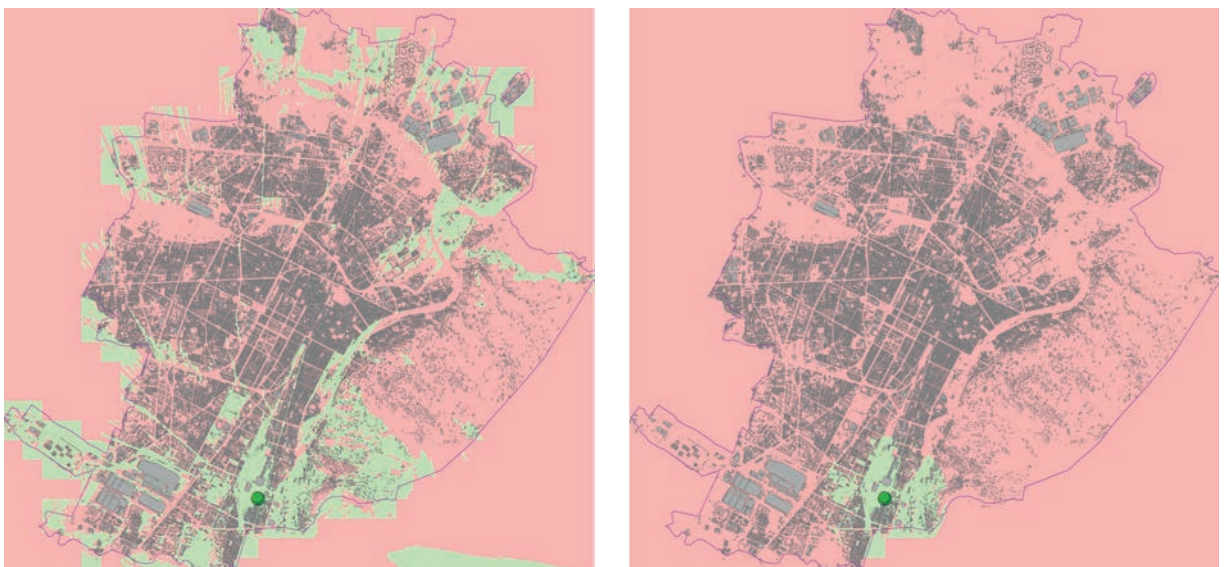
DATA AND RESULTS

The test area lies in Turin, northwest Italy. The bare ground heights were derived from a recent digital elevation model (DEM) of the Piedmont region, captured by airborne Lidar with an average density of 1 point per 5m² and interpolated to a grid of 10 x 10m. A map, scaled at 1:1,000 and containing eave outlines of buildings and their heights above street level, was transferred into a raster layer with a

distances can be averaged over a certain time span, e.g. a week, month or year. The city of Turin, which has

the difference may be up to 7km. This method does not simply perform averaging but instead selects the

► Figure 2, Visibility maps: green indicates visible areas from a distance of 20km (left) and 1.6km.



cell size of 0.5 x 0.5m using ArcGIS tools. Also the DEM was resampled to a grid size of 0.5 x 0.5m. Merging both datasets created a raster including the buildings and their heights, which are shown as simple blocks (Figure 1). The skyscraper has a square footprint of 45 x 45m. Its height is 210m, the foot lies at 234.50m above reference level and the top lies at 444.50m for all four corner points. If one of the four corner points is visible, then the building is indicated as visible. Using geometric computations and visual acuity, the length of the line of sight appeared to be 218km. Subsequently, visibility constraints were introduced based on atmospheric conditions. Figure 2 shows two maps, each computed within 30 minutes, using

the visibility distances of 20km and 1.6km.

CONCLUDING REMARKS

The method allows it to be determined at design stage how the (psychological) perception of places in an urban landscape will

change when new buildings are erected or existing buildings are demolished. This provides valuable information for architects and city planners. The use of colour contrast between a building and its surroundings allows refinement of the method. ◀

FURTHER READING

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- Xia Z, Qing Z, (2004) Applications of 3D city model-based spatial analysis to urban design, *International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences XXXV-Part B* 325-329.

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