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3D Models of Major Cities for Estimating Losses due to Earthquakes

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Method

- Orthorectify a high-resolution satellite image of the city.
- Construct a 3D model, including all visible buildings.
- Count the number of buildings in each of 5 height classes (one story, two stories, 3-5 stories, 6-10 stories, taller).
- Identify each building's use approximately (residential, office, industrial, monument).
- Use local information from engineers to construct fragility curves for the existing building types.
- Assign the appropriate percentage of each height class to a fragility class.

Project TRANSFER 3D Models of Harbor Cities to estimate tsunami impact



Detailed 3D models of harbor cities are constructed to allow tsunami modelers and harbor engineers to estimate the location, depth and speed of water flow into the streets of such a city, in case of a tsunami attack.



High resolution satellite image of Cadiz (above) and Rhodos (at right). 3D models will be constructed for both of these harbor cities. The photo below is shot in a westerly direction from the point marked by the red flag.

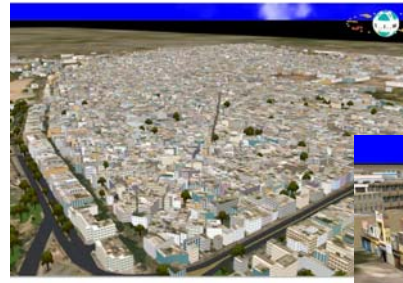


Photos of the waterfront assist with height estimation of buildings and fragility assessment.

Introduction

Estimating losses due to earthquakes in real-time is essential for launching appropriate rescue operations. For loss estimates, information on the number of buildings, their type and their quality of construction is required. Because this information is often not available, or it is poor or incomplete for large cities in earthquake-prone areas, we are developing a method to derive as much information as possible about the building stock from 3D models of cities.

Projects New Delhi, Dubai, Abu Dhabi



For special jobs, information on physical properties of buildings can be derived from photographs taken from the ground, and the building use, as well as occupancy can be obtained from surveys by questionnaires.



The two figures above and that to the left show 3D models constructed from a combination of satellite images and photos of the facades from the ground. If desired, special attention can be paid to monuments, like the Temples and Moshe on the left.

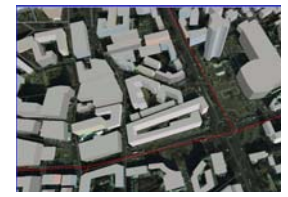
Along with the 3D model of Dubai to the right, addresses of businesses in each building are distributed by Informap Inc.



In detailed 3D models, like the one of Abu Dhabi on the left, infrastructure like streets, bridges, GIS layers of critical facilities and lifelines can be constructed in part from satellite images.

Project SAFER (early warning) Buildings by Height in Bucharest for Estimating Losses due to Earthquakes

From the ortho-image (left) a 3D model for every building is constructed (right) and put in a GIS database.

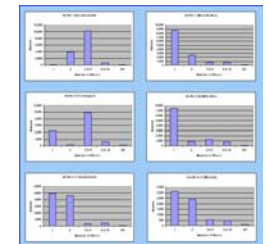


The difference in height distribution in different sections of the city is evident.



In Bucharest there are six districts within which the population is known and we counted the buildings.

Distribution of building heights is similar in two districts, but different in others. Thus, different damage extents can be estimated by district.



Outlook

Given that 3D models will be constructed for all major cities of the world for cell phone communication, there is hope that models for the fragility of these cities in case of earthquakes will also be developed.