

Chapter III

3D Modelling of Urban Environment: Data Collection Techniques

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INTRODUCTION

Sustainability and protection of the environment are requirements of high priority in our society. These tasks need an efficient monitoring of the environment. The information gathered should be accurate and up-to-date for all kinds of decision making, planning, simulation and analysis. All environmental information systems are data-hungry and once established require continuous maintenance to keep track of changes in the physical environment. The built-environment is obviously one of the most interesting areas, with regular changes and constant need for updated information. An out-of-date database is arguably worse than having no database because of the false sense of certainty it carries. If there is no database, model etc. then at least users are aware of their lack of information and cannot rely on inaccurate data. In the context of these topics we are using the term 'environment' to denote the urban physical structures. We do not regard in this chapter applications related to the physical environment as it expresses itself in terms of different forms of pollution, e.g. noise, emissions, etc. Examples for those are given in several of the other chapters. We regard those applications as potential users of geo-spatial information on the built-up area of a city.

Most of the information required has a geo-spatial element, most often in the form of geographic coordinates. One of the most important tasks in urban data collection today is the acquisition of proper data to be able to establish realistic models of the built-up areas. While so far mainly two-dimensional information on maps and digital data bases are used, a new emerging area is the usage of three-dimensional information. There are several reasons why it is desirable to have access to three-dimensional models. Tasks like the simulation and analysis of pollution, noise, microclimate etc., planning and restoration tasks of urban areas or the planning of communication networks in built-up areas, either build on three-dimensional

models, or they give results with much higher reliability and accuracy compared to cases where only two-dimensional information is used. In the following we will concentrate on the aspect of 3D modelling of the urban environment.

The costs associated with model and database maintenance are often overlooked in research projects, but not by the eventual users of environmental information systems. Long-term experience shows, that the value of data can be as high as 80% of the total costs of implementing/maintaining an environmental information system. This is due to the fact, that the collection of precise and up-to date geo-spatial information in the urban environment is costly, be it in 2D or 3D, which is certainly caused by the complex nature of the urban environment as well as by the frequent changes of all kinds.

This chapter will deal with data collection techniques for 3D city models. We want to give an overview on currently used techniques, which are mainly based on photogrammetric or geodetic principles. This is also due to the fact, that we have observed a great lack of information about such techniques in other communities. If costs for data collection are to be reduced then it seems clear that further advances are needed in data collection and data management, i.e. the synchronization of existing data sets with revised data.

There are certainly different demands on the quality and level-of-detail of 3D city models. This holds not only for a numerical analysis, but also for visualization. For both applications, many organizations are content to work with fairly crude models of the built environment as ‘faceless’ blocks, for example. But this type of model is of little use to planners or architects who may wish to view new design proposals against the context of the existing urban fabric. As the costs for data acquisition are so high, there is or should be a general trend to multi-usage of data to share the costs by offering it to customers from different application areas.

The type of tools used for data acquisition in urban environment have to take into account not just the cost of data collection and maintenance but the level of detail required in the data. In order to cover as many applications as possible, the initial data collection should be on the highest economically feasible level of detail. It is certainly possible to reduce the level of detail with automated methods, for instance to generate a simple building block covering the maximum extension of a very detailed modelled saddleback-roof building with chimneys, dormers and the like, but not vice-versa. The last years have shown, that after having established a large range of city models at a certain crude level of detail, the demands on better quality immediately appeared and required a completely new data collection phase.

Photogrammetry (e.g. Kraus, 1993; 1997) is the most economic method today to gather large amounts of precise geometric 2D and 3D data city wide or nation wide. The process of photogrammetric data acquisition for 2D mapping tasks or the derivation of a Digital Elevation Model (DEM) is well established. The data sources are aerial or terrestrial images, the measurement (actually in full 3D) is done with special instruments, so called analytical stereoplotters by experienced human operators.

Several years ago a tremendous development was started in Germany to gather 3D data for the modelling of the urban environment pushed by the urgent needs of mobile phone companies for the simulation of wave propagation in urban areas. Three major mobile phone companies generated 3D city models for all German cities

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