

A Survey of Urban Reconstruction

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Abstract

This paper provides a comprehensive overview of urban reconstruction. While there exists a considerable body of literature, this topic is still under very active research. The work reviewed in this survey stems from the following three research communities: computer graphics, computer vision, and photogrammetry and remote sensing. Our goal is to provide a survey that will help researchers to better position their own work in the context of existing solutions, and to help newcomers and practitioners in computer graphics to quickly gain an overview of this vast field. Further, we would like to bring the mentioned research communities to even more interdisciplinary work, since the reconstruction problem itself is by far not solved.

Categories and Subject Descriptors (according to ACM CCS): Computer Graphics [I.3.5]: Computational Geometry and Object Modeling—; Image Processing And Computer Vision [I.4.6]: Segmentation—; Image Processing And Computer Vision [I.4.8]: Scene Analysis—;

1. Introduction

The documentation of the cultural heritage of our world is a vivid task of many research areas. Also in the field of computational sciences, the reconstruction of cities has obtained a significant attention in recent years. Urban reconstruction is an exciting area of research with several potential applications. Despite the high volume of previous work, there are many unsolved problems, especially when it comes to the development of fully automatic algorithms.

Urban reconstruction is a wide spread domain. Practical fields that benefit from reconstructed three-dimensional urban models are multiple as well:

- In the entertainment industry, the storyline of several movies and computer games takes place in real cities. In order to make these cities believable at least some part of the models are obtained by urban reconstruction.
- Digital mapping for mobile devices, cars, and desktop computers requires two-dimensional and three-dimensional urban models. Examples of such applications are Google Earth and Microsoft Bing Maps.
- Urban planning in a broad sense relies on urban recon-

struction to obtain the current state of the urban environment. This forms the basis for developing future plans or to judge new plans in the context of the existing environment.

- Applications such as emergency management, civil protection, disaster control, and security training benefit from virtual urban worlds.

From the economical standpoint, there is an enormous benefit of being able to quickly generate high-quality digital worlds in the growing virtual consumption market.

1.1. Scope

Urban habitats consist of many objects, such as people, cars, streets, parks, traffic signs, vegetation, and buildings. In this paper we focus on urban reconstruction, which we consider as the creation of 3d geometric models of urban areas, individual buildings, façades, and even their further details.

Most papers discussed in this survey were published in computer graphics, computer vision, and photogrammetry and remote sensing. There are multiple other fields that contain interesting publications relevant to urban reconstruction,