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Chapter I

Advances in Vision-Based Human Body Modeling

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Abstract

This chapter presents a survey of the most recent vision-based human body modeling techniques. It includes sections covering the topics of 3D human body coding standards, motion tracking, recognition and applications. Short summaries of various techniques, including their advantages and disadvantages, are introduced. Although this work is focused on computer vision, some references from computer graphics are also given. Considering that it is impossible to find a method valid for all applications, this chapter

intends to give an overview of the current techniques in order to help in the selection of the most suitable method for a certain problem.

Introduction

Human body modeling is experiencing a continuous and accelerated growth. This is partly due to the increasing demand from computer graphics and computer vision communities. Computer graphics pursue a realistic modeling of both the human body geometry and its associated motion. This will benefit applications such as games, virtual reality or animations, which demand highly realistic Human Body Models (HBMs). At the present, the cost of generating realistic human models is very high, therefore, their application is currently limited to the movie industry where HBM's movements are predefined and well studied (usually manually produced). The automatic generation of a realistic and fully configurable HBM is still nowadays an open problem. The major constraint involved is the computational complexity required to produce realistic models with natural behaviors. Computer graphics applications are usually based on motion capture devices (e.g., magnetic or optical trackers) as a first step, in order to accurately obtain the human body movements. Then, a second stage involves the manual generation of HBMs by using editing tools (several commercial products are available on the market).

Recently, computer vision technology has been used for the automatic generation of HBMs from a sequence of images by incorporating and exploiting prior knowledge of the human appearance. Computer vision also addresses human body modeling, but in contrast to computer graphics it seeks more for an efficient than an accurate model for applications such as intelligent video surveillance, motion analysis, telepresence or human-machine interface. Computer vision applications rely on vision sensors for reconstructing HBMs. Obviously, the rich information provided by a vision sensor, containing all the necessary data for generating a HBM, needs to be processed. Approaches such as *tracking-segmentation-model fitting* or *motion prediction-segmentation-model fitting* or other combinations have been proposed showing different performances according to the nature of the scene to be processed (e.g.. indoor environments, studio-like environments, outdoor environments, single-person scenes, etc). The challenge is to produce a HBM able to faithfully follow the movements of a real person.

Vision-based human body modeling combines several processing techniques from different research areas which have been developed for a variety of conditions (e.g., tracking, segmentation, model fitting, motion prediction, the