ACCURATE CAPTURE OF 3D FULL-BODY MOTION USING A SINGLE CAMERA

A Dissertation

by

XIAOLIN WEI

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

December 2011

Major Subject: Computer Science

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Approved by:

Chair of Committee,	Jinxiang Chai
Committee Members,	John Keyser
	Scott Schaefer
	Jianhua Huang
Head of Department,	Hank Walker

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ABSTRACT

Accurate Capture of 3D Full-body Motion
Using A Single Camera. (December 2011)
Xiaolin Wei, B.S, Xidian University
Chair of Advisory Committee: Dr. Jinxiang Chai

In the past decade, motion capture technologies have enabled tremendous advancement in creating realistic human characters for virtual worlds, performing biomechanical studies of human movement, and providing natural user interfaces for interacting with computers, robots, and machines. However, current motion capture technologies are often limited to high-end applications because they are restrictive, expensive, and require special skills to set up and operate. This dissertation explores a new generation of motion capture technologies that address such challenges.

We focus our study on two important and challenging motion capture problems: high-fidelity motion capture using a single video camera and online motion capture using a single depth camera. We first introduce a new video-based motion capture technique for reconstructing physically realistic full-body motion from single-camera video streams such as Internet videos. During reconstruction, we leverage Newtonian physics, contact constraints, and 2D image measurements to simultaneously reconstruct full-body poses, joint torques, and contact forces. across an entire sequence. For online applications, we develop a motion capture system that accurately captures 3D full-body movements in real time using a single depth camera. Both systems are appealing for home use because they are low-cost, easy to set up, and allow for accurate motion capture even with significant occlusions.

For both systems, we assess the quality of the reconstruction results by comparing against those created by a commercial optical motion capture system. We demonstrate the quality of the reconstructed motions created by our systems is comparable to commercial motion capture systems, but our systems are far less expensive, restrictive, and cumbersome.

More information about this dissertation can be found in digital repository at Texas A&M University: http://hdl.handle.net/1969.1/ETD-TAMU-2011-12-10566.

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