ANIMATING HUMAN FIGURES: PERSPECTIVES AND DIRECTIONS

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ABSTRACT

The overall goal of our work is human motion understanding. In particular, motion performance, observation, description, and notation impacts the form of a motion representation. A representation can be verified by a computer graphics performance, and thus the effective control of natural-appearing human figure movement is a significant and challenging goal. Characteristics of a computationally realizable human movement representation are discussed, including distinctions between hierarchic levels, kinematics, and dynamics. The qualitative factors of Effort-Shape notation are used to suggest extensions to existing movement representations in directions consistent with known characteristics of human movement and conventional animation. We show how useful and expressive motion qualities may be at least approximated by a combination of kinematics and dynamics computations, with kinetic control modulated by acceleration and decelerations derived from existing interpolation methods. Interactions between motions by phrasing, temporal properties, or relationships may be described and executed within an appropriately detailed model.

RÉSUMÉ

L'objet de notre étude est la compréhension du mouvement humain. Plus particulièrement, le fonctionnement du mouvement, son observation, sa description et sa notation ont un impact sur l'organisation de la représentation du mouvement. Celle-ci peut être controllée à l'aide de l'informatique graphique, mais un control adéquat du naturel de l'apparance du mouvement du corps humain est un défi à relever. Différentes caractéristiques de la réalisation du mouvement par informatique sont examinées. On distingue notamment la kinématique, la dynamique et les niveaux hyérarchiques. Les facteurs qualitatifs d'une notation "Effort-Shape" précise sont utilisés pour évoquer l'extension de la représentation actuelle du mouvement vers une une direction compatible avec les caractéristiques courantes du mouvement et de l'animation. Nous démontrons comment certaines qualités significatives du mouvement peuvent être approximées par la dynamique et la kinématique avec le control de la cinétique modulée par l'accélération et la décélération ces deux dernières étant dérivées par les méthodes d'interpolation conventionnelles. L'interaction entre l'expression du mouvement et les propritées temporelles peuvent être décrites et exécutées selon les limites d'un modèle pertinnement détaillé.

KEYWORDS: Human movement, motion understanding, movement representation, computer animation, simulation, computer graphics, dynamics.

EXTENDED ABSTRACT

INTRODUCTION

A significant portion of our activities and perceptions are associated with the performance, observation, description, or recording of human movement. It is a challenge to the current state of knowledge in Computer Science to similarly represent, simulate, and integrate these differing manifestations of human movement since they touch on such seemingly diverse areas as computer graphics, computer vision, robotics, and computational linguistics [6]. In this exposition we shall discuss the philosophy and methodology behind our research into the computational understanding of human movement, concentrating on the issues of movement representation, movement synthesis, and task specification. While our primary emphasis will be on performance, that is, the animation or simulation of natural human motion, we cannot avoid inquiring what our representational decisions would imply for a general theory of human movement understanding.

We will try to examine human movement in the most global view possible, namely, that a movement representation should be at least sympathetic to the needs and character of each modality: performance (or control), observation, language description, or symbolic recording. Our own research, and certainly that of others, has touched all these areas: for example, computer graphics for human motion synthesis [9, 16, 65, 33, 41, 38, 21], computer vision for motion and shape analysis [46, 1, 36], movement notations for symbolic motion representation [29, 63, 9, 15], language analysis for motion verb characterization [45, 4, 23], and robotics for path planning and goal-directed behavior [35, 34]. Having originally examined motion descriptions based on visually-observable data [4], the inadequacy of this view by itself is keenly felt. Such descriptions may serve as a target for information reduction, but are apt to be the product of convenience dictated by the observational task at hand. Such a description differentiates between phenomena of interest, possibly incorporating rudimentary notions of direction, velocity, and shape. Likewise, representations derived solely from language [56] omit essential information needed to reconstruct an acceptable performance.

By turning to representations derived from graphical performance or physical object control (for example, robotics), we get a different perspective. In particular, representations based on these end products will have the property that a graphical or physical *performance will verify that a representation is adequate to characterize some* (hopefully broad) *class of human movement.* It is