3rd International Conference
ðResearch & Innovation in Engineering ð
COMAT 2014
16-17 October 2014, Braşov, Romania

CURENT MOTION CAPTURE TECHNOLOGIES USED IN HUMAN MOTION ANALYSIS

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Abstract: *In the medical field, motion analysis of human body parts is essential. In analyzing gait and posture, joint angles are used to track the location and orientation of the body. Human gait analysis is essential in medical recovery as it provides quantitative information of segment body while walking. Motion capture systems can track any moving object. A perfect system of motion capture should be small, compact, precise, wireless / wireless, without error, to cover several areas of research or study and obviously must be cheaper, which is a system that is not really feasible. We present existing technologies, which present better ways of capturing human motion and different uses.*
Keywords: *biomechanics, recovery/ regenerative/ rehabilitation, human motion analysis, gait analysis, tracking*

1. INTRODUCTION

From the mechanical point of view, biomechanics study the process by which muscle forces are formed, and how they interact with the forces acting on the body. Thus, the biomechanics in the process of physical exercises for recovery medicine, determine their effectiveness in terms of mechanical, and recommended methods for improving the recovery process taking account of the gym / training recovery used.
Favorable medical results in diagnosis and treatment are closely linked with clinical outcome. The same principle applies to the field of orthopedics, the field where is necessary, if not mandatory, a constant and intensive information and training linked to new technologies.
In the medical field, motion analysis of human body parts is essential. In analyzing gait and posture, joint angles are used to track the location and orientation of the body.
Human motion analysis has long been studied and applied in various fields. The field which studied specifically human gait features is called gait analysis. Human gait analysis is essential in medical recovery as it provides quantitative information of segment body while walking.
In general, human walking can be measured by direct measurement techniques and also by optical measurement techniques. The main problem in the direct measurement technique is the fact that people analyzed should wear cables or other components of the equipment that may affect the movement of walking [WIN 2009] contrary to optical measurement technique.
Analysis of human movements can be grouped as follows: identification of human activity, human motion tracking and motion analysis body or parts of the body [MIH 2011].
Motion capture represents the Digital recordings activity of human body movements. Thus, the motion capture (Mo-cap) is formed from a mathematical representation of the motion of a subject. Currently, it is possible to convert a video into a digital model almost instantly, and its use in further studies and specific applications.

2. MOTION CAPTURE TECHNOLOGIES

Motion capture systems can track any moving object. A perfect system of motion capture should be small, compact, precise, wireless / wireless, without error, to cover several areas of research or study and obviously must be cheaper, which is a system that is not really feasible. We present existing technologies, which present better ways of capturing human motion and different uses.
It is necessary to study the structure and the characteristics of each sensor to determine the source of error or noise, which usually accompanies the data acquisition. The following is a description of the existing motion capture technologies to perform a proper investigation.

Motion capture technologies existing today can be divided into two main branches: Optical (visual), for example markers or no markers, and non-optical (non-visual). Non-optical branch include inertial devices, electromechanical and electromagnetic, while the optical is based on markers-based or markers-less systems (Figure 1.), [PER 2001].

2.1 Non-Optical Systems

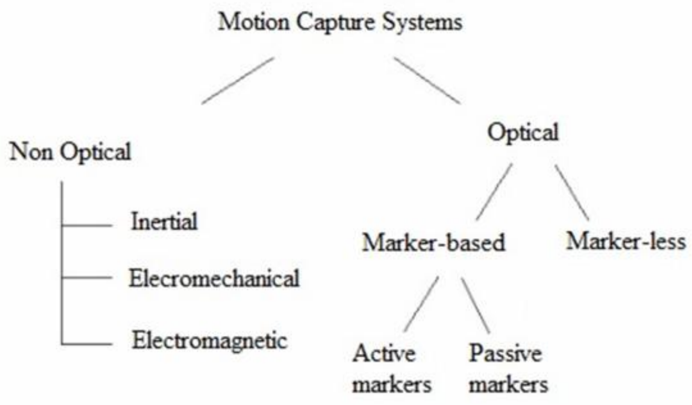

Figure 1. Motion Capture Classification

Inertial motion capture systems are based on miniature inertial sensors, biomechanical models and sensor fusion algorithms. These systems are easy to use and profitable for motion detection.
Inertial sensors are electronic devices that measure and represent the speed, acceleration, orientation, and gravitational forces of an object using a combination of accelerometers and gyroscopes sometimes magnetometers. In Figure 2. is presented an accelerometer, which is physically compact and lightweight, so it has been widely used in portable devices (such as devices for head). In addition, the accelerometer results

Figura 2. Accelerometers made by Entran Sensors &Electronics, [*** rel]

are immediately available without complicated calculation. Details of the inertial motion sensor are wirelessly transmitted to a data base for subsequent post-processing. This feature accelerometers, has great importance for people who just need basic information of accelerations.
Electromechanical systems generally consist of potentiometers and sliding sticks fixed at specific points in the body. Motion capture is achieved by detecting small changes in potentiometers. Because they are bulky and heavy, these systems cannot analyze simple activities such as walking.
Electromagnetic devices involve the use of sensors able to record changes in an electromagnetic field. The system is much easier and comfortable making it possible to increase the range of motion possible for the capture compared to electromagnetic system but require wires attached to each sensor, however, limited [BRA 2001].

2.2. Optical Systems

Optical sensor systems (such as cameras) are commonly used to improve accuracy in assessing body position. Are currently the most popular systems, because the video quality is an advantage over other techniques.

2.2.1. Optical marker-based systems.

These marker-based tracking systems can be passive or active. Thus, a passive system use a number of markers which do not generate any light, they reflect incoming light only, and the markers of an active system may cause light, which is infrared, which is then captured by a video system.

Passive optical markers-based systems are the most common being popular for entertainment, biomechanics, engineering, particularly in clinical applications, etc. In these systems, data acquisition is achieved by using retro reflective markers, which are attached to the skin of the subject according to various protocols. The scene is illuminated with infrared light produced by a number of emitting diodes mounted around the lens digital cameras that will record each stage. Tracking the markers is particularly simple because reflective material that covered their surface reflects light back, making them much brighter than the background. Moreover, the camera can be adjusted so that only the bright reflective markers to be sampled, ignoring skin and fabric [MED 2001]. Passive markers are usually spheres or hemispheres or foam plastic 25 to 30 mm in diameter special reflective tape. Manufacturers of this type of system are Vicon-Peak [*** vic], Motion Analysis [*** bow] and STD [*** bts].

Active optical marker-based systems have advantages over passive because there is no doubt about the identification of the markers, emitting light themselves. These systems are used primarily in the field of biomechanics. Markers usually are activated sequentially, so that the system can automatically track each marker making the tracking easier. However, it is preferred to use passive markers since the electrical systems need required to supply the markers can

Figure 3. CODA System, [*** cod]

prevent the possible movements of the subjects [CAP 2003].

Using markers and / or special clothes-equipment (to ensure maximum visibility of the markers are worn special suits – which are tight on the body) may reduce the quality and the actual movement of itself such as training applications, where athletes would wear very different sports equipment.

In Figure 3 there is shown a tracking active optical markers-based system - CODA, which has been pre-calibrated for 3-D measurement and can be used together up to six sensor units, which allow the system 3608 to track 3608 movements.

2.2.2 Optical Marker-less Systems

Optical Marker-less Capture Systems use only optical sensors to measure the movements of the human body. Their use is motivated by the errors that occur during the use of optical markers-based systems.

Cameras with high pixel resolution used indicate the high accuracy of motion detection. The cost of high-speed cameras is much lower, and camera parameters can be flexibly set by the user, making them accessible and desirable to supervision main. The disadvantage with this markers-less system is that the technique requires intensive computation to determine the 3D location of the error reduction.

Tracking human body motion markers-less is challenging, but the applications of these systems demonstrate promising performance. For example, interest in virtual reality applications has increased in recent years, especially in the automotive industry, gaming industry, etc.

3. CONCLUSION

An existing motion capture technologies are presented in this article and summarized their application in regenerative medicine. Capture techniques were classified optical and non-optical systems, and were described.
In future work will be used the optical marker-based system for motion analysis of human gait in medical recovery

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