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Inertial Motion Capture System for Biomechanical Analysis in Rehabilitation and Sports

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Abstract : The inertial motion capture systems (mocap) are among the most suitable tools for quantitative clinical analysis in rehabilitation and sports medicine. The inertial measuring units (IMUs), composed by accelerometers, gyroscopes, and magnetometers, are able to measure spatial orientations and calculate displacements with sufficient precision for applications in biomechanical analysis of movement. Furthermore, this type of system is relatively affordable and has the advantages of portability and independence from external references. In this work, we present the last version of our inertial motion capture system, based on the foregoing technology, with a unity interface designed for rehabilitation and sports. In our hardware architecture, only one serial port is required. First, the board client must be connected to the computer by a USB cable. Next, an available serial port is configured and opened to establish the communication between the client and the application, and then the client starts scanning for the active MOCAP_S servers around. The servers play the role of the inertial measuring units that capture the movements of the body and send the data to the client, which in turn create a package composed by the ID of the server, the current timestamp, and the motion capture data defined in the client pre-configuration of the capture session. In the current version, we can measure the game rotation vector (grv) and linear acceleration (lacc), and we also have a step detector that can be abled or disabled. The grv data are processed and directly linked to the bones of the 3D model, and, along with the data of lacc and step detector, they are also used to perform the calculations of displacements and other variables shown on the graphical user interface. Our user interface was designed to calculate and present variables that are important for rehabilitation and sports, such as cadence, speed, total gait cycle, gait cycle length, obliquity and rotation, and center of gravity displacement. Our goal is to present a low-cost portable and wearable system with a friendly interface for application in biomechanics and sports, which also performs as a product of high precision and low consumption of energy.

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