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A 3-Dimensional Memory-Based Model for Planning Working Postures Reaching Specific Area with Postural Constraints

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Abstract : The current 3-dimensional (3D) posture prediction models commonly provide only a few optimal postures to achieve a specific objective. The problem with such models is that they are incapable of rapidly providing several optimal posture candidates according to various situations. In order to solve this problem, this paper presents a 3D memory-based posture planning (3D MBPP) model, which is a new digital human model that can analyze the feasible postures in 3D space for reaching tasks that have postural constraints and specific reaching space. The 3D MBPP model can be applied to the types of works that are done with constrained working postures and have specific reaching space. The examples of such works include driving an excavator, driving automobiles, painting buildings, working at an office, pitching/batting, and boxing. For these types of works, a limited amount of space is required to store all of the feasible postures, as the hand reaches boundary can be determined prior to perform the task. This prevents computation time from increasing exponentially, which has been one of the major drawbacks of memory-based posture planning model in 3D space. This paper validates the utility of 3D MBPP model using a practical example of analyzing baseball batting posture. In baseball, batters swing with both feet fixed to the ground. This motion is appropriate for use with the 3D MBPP model since the player must try to hit the ball when the ball is located inside the strike zone (a limited area) in a constrained posture. The results from the analysis showed that the stored and the optimal postures vary depending on the ball's flying path, the hitting location, the batter's body size, and the batting objective. These results can be used to establish the optimal postural strategies for achieving the batting objective and performing effective hitting. The 3D MBPP model can also be applied to various domains to determine the optimal postural strategies and improve worker comfort.

Keywords : baseball, memory-based, posture prediction, reaching area, 3D digital human models
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