# The Biomechanical Model to Optimize the Vertical Jump

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The vertical jump performance depends on the movement pattern of particular take-off force. This study aims to design a biomechanical model to describe the optimization of an athlete's vertical jump height (VJH). Though lower extremity movement has been studied to optimize the vertical jump, in this study, the movement of the upper extremity and its influence on the VJH observe through the biomechanical model. The conservation of momentum of an athlete's center of gravity (CG) in the air is considered to design the biomechanical model. A jumper (1.85 m, 70 kg) of a Chinese high jumper (best performance 2.20m) was selected to test the model. Ten high-speed cameras (ViconT40S, 100Hz) setup and reflective markers (14mm) were used to determine the time history of attached markers on the joints of subjects. The 3D coordinates of the necessary markers were calculated using ViconT40S digitizing software. According to the biomechanical model, VJH optimizes at the zero velocity of CG is zero with special placement of arms: arms are extended, one arm vertically upward (shoulder angle $180^0$), the next arm downward (shoulder angle $0^0$), and maximum relative vertical displacement of shoulders. The subject also describes the special shoulder position is influenced to optimize VJH by 4.30+0.01 cm for his maximum take-off velocity.

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