Kinematic analysis and optimization of jerk using elasticity of weightlifting bar in clean & jerk

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Abstract

In order for weightlifters to achieve good technical skills in clean & jerk, a study of kinematic analysis and optimization of jerk using elasticity of weightlifting bar in clean & jerk is conducted. First of all, barbell's trajectory, which leads to derivation of barbell's velocity and acceleration over time, is tracked from video clip filmed the lifter's performance by image processing technology including pattern recognition. Since clean lift in clean & jerk is similar to snatch lift in principle, focus is only on jerk just after finish of clean lift. Five kinematic characteristics- "Jerk-Preparing-Time", "Jerk-Drive-Velocity", "Jerk-Time", "Jerk-Offset" and "Jerk-Drop" are newly introduced to evaluate the jerk technique. Then, a kinematic model which is comprised of springs and dashpots is proposed in order to simulate and optimize the jerk using elasticity of weightlifting bar. Spring constant and damping coefficient of the model is estimated by analyzing the barbell's oscillation on the shoulder. Besides, spring constant is calculated by theory of bending of beam, as well. Finally, an optimal control problem based on the proposed kinematic model is formulated and solved to optimize the jerk. The methodology is illustrated with case study, showing good agreement with actual lifts. It could be useful for optimizing clean & jerk technique.

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