Prediction of hammer speed from cable force in the hammer throw.

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Introduction

Due to the projectile nature of the hammer after release the most important release parameter with respect to distance thrown is the release speed. As result it is vital that athletes ensure the acceleration to the release speed is optimal. Currently the most accurate way to determine speed data is via hammer head positional data and the fastest way to determine positional data is via automatic tracking. This will usually require post-processing and as such does not allow immediate feedback in the training environment. For athletes to improve technique it is important to provide accurate information about their performance as soon as possible after the event; delays in providing such information reduce the effectiveness of feedback[1].

This study's purpose was to determine and validate a model that predicts hammer speed from cable force in order to provide feedback on speed development in the training environment.

Methodology

Five males and five females participated in this study and each was required to perform 10 throws with a hammer that had a strain gauge mounted on its wire. Retro-reflective markers were also positioned on each wire at known distances from the hammer's head. Each strain gauge was calibrated by applying forces to the wire that were measured by a force link (Kistler, Amherst USA). These data were later used to determine the relationship between strain gauge A-D units and force by performing a linear regression. The resultant regression was then used to convert the strain gauge throw A-D data into force.

Positions of the markers were tracked with an infra-red camera system (Oxford Metrics, Oxford UK) and these positional data were used in conjunction with direction cosines to determine the hammer head's position. From this, linear hammer speed and cable force were calculated[2]. This speed and force data were used to determine two linear regression models that predict speed from force data: one where the data sets were shifted so that the peaks in force and speed lined up and one where neither data set was altered. These two models were used to predict speed from cable force data that were measured using the strain gauge device.

Results

Using the models and strain gauge data allowed prediction of speeds that were nearly identical to the speeds calculated from positional data ($R = 0.98$ for both). The average difference between the calculated speeds and speeds predicted via the non-shifted model was 0.89 ± 0.68 m.s^{-1}. The difference when using the shifted model was 0.46 ± 0.70 m.s^{-1}.

Conclusion

The results of this study indicate that use of the models and the measured cable force data allowed prediction of highly accurate speed data however; the shifted regression model predicted data that were slightly more accurate.

References

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