ARTISTIC GYMNASTICS VAULTS VERTICAL TAKE OFF VELOCITY MEASURED BY ELECTROMECHANICAL FILM

Keränen, T.[1], Moisio, T.[2] and Linnamo, V.[3]

KIHU - Research Institute for Olympic Sports[1], Finland. Aspire Academy for Sports Excellence [2], Qatar. Neuromuscular Research Centre, Department of Biology of Physical Activity, University of Jyväskylä [3], Finland

INTRODUCTION

The takeoff phase is a critical aspect of the gymnastics vault. During the later phases of the vault it is difficult to compensate for errors made during the takeoff. Vertical takeoff velocity at the board phase has a high correlation of coefficient with the judges points (Takei et al. 2000) and gymnast level of athlete (Takei et al. 2003). It can be measured using high-speed cameras and motion analysis, which is time consuming and does not provide immediate feedback. Therefore the purpose of this study was to determine whether it is possible to evaluate and at which accuracy the vertical takeoff velocity from the takeoff force-time curve measured by an electromechanical film (EMF).

METHODS

Measurements were completed during the male's equipment practice with 8 elite gymnastics as subjects, a day before match against Fin-Swe-Eng-Lat in Jyväskylä, Finland. Six thin (70 µm) EMF stripes (EMFiT, Emfitech Ltd) were assembled into the springboard under the carpet cover on the hard board (Fig 1).

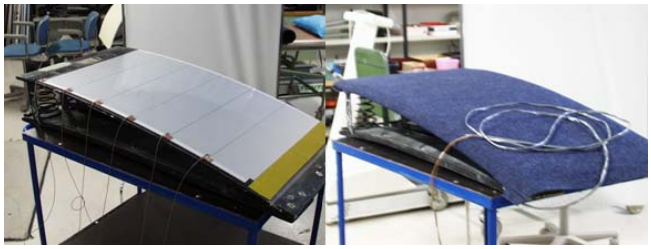

Figure 1. *Six EMF stripes and measuring ready springboard.*

Each EMF sampling rate was 1000 Hz. Signals were corrected with a digital transfer function and calibrated to force units. Stationary high speed camera (125 Hz) filmed the flight phase to the springboard and the takeoff perpendicularly to the jumping direction. The takeoff area was calibrated 2D by calibration sticks. A total of 13 vault video recordings were digitised manually, transformed, filtered and analyzed using the movement analyse system (APAS).

The eccentric force was excluded from the force-time curve by two different methods. In the first method (VY1) the eccentric force was determined from the start of the force production to the point where the athlete's vertical centre of mass changed from the negative to the positive according to the APAS. In the second method (VY2) eccentric force was calculated according to the average negative vertical velocity at the board contact (-1.2 m/s) for all subjects. This constant value was chosen because the standard deviation over the subjects was small (0.15 m/s).

RESULTS

The takeoff time was 111±5 ms (APAS) and 108±3 ms (EMF). The athlete's centre of mass vertical direction changed from negative to positive at 23±4 ms (Fig 2). The vertical takeoff velocities were 4.09±.24 m/s (APAS), 4.08±.31 m/s (VY1) and 4.09±.32 m/s (VY2). These values did not differ from each other (p = 0.965).

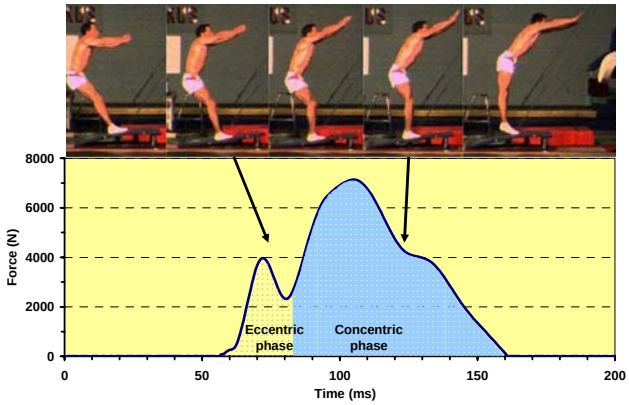

Figure 2. *Example of one subject's takeoff force-time curve.*

DISCUSSION

In the present study vertical takeoff velocity was higher than reported in the 1995 World Championships where the value was 3.3 m/s (Takei et al. 2000). One reason for this discrepancy might be that new vaulting table was introduced 2001 and the takeoff technique may have also changed. From the force-time curve, measured by the EMF-technique, it was possible to evaluate the takeoff vertical velocity. Among male athletes at the national team level the second method (VY2) could be used to get acceptable vertical takeoff velocities compared to the movement analysing system.

It was concluded that the EMF based force measuring system could offer instant feedback for athletes and coaches.

REFERENCES

Takei et al. (2000) J Sports Sci 18, 849-863

Takei et al. (2003) Sports Biomech 2, 141-162

tapani.keranen@kihu.fi