

VALIDATION OF RELATIVE COM DISPLACEMENT IN V2 SKATING OBTAINED WITH INERTIAL SENSORS – A FEASIBILITY STUDY

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Keywords: v2 skating, center of mass, inertial sensors, validation

INTRODUCTION

For precise estimation of the athlete's CoM during skiing 3D video analysis is required. Such systems are complex to set up and cannot be used on snow for covering large distances. Alternative solutions using inertial sensors have been proposed but were too simple for taking into account arm movement (Myklebust et al., 2015). The aim of this project was to design and validate an inertial sensor based algorithm for estimating CoM displacement where limb motion was also considered.

METHODS

The full body model designed for alpine ski racing (Fasel et al., 2016) was extended to include upper limbs. 10 inertial sensors (500Hz) were attached to shanks, thighs, sacrum, C7, arms, and wrists. Segment inertial parameters were taken from (Dumas et al., 2007). Reference CoM was derived from the Plug-In Gait marker setup extended to cross-country skiing (Göpfert et al., n.d.). One female athlete performed the V2 skating technique on treadmill at 8km/h and 12km/h. For validation purpose the CoM was expressed relative to the mid-point between left and right antero-superior iliac spine. The anterior-posterior (AP) axis was defined to be parallel to the treadmill, pointing forwards and the medio-lateral (ML) axis was pointing horizontally to the left.

RESULTS

Errors were similar for both speeds. For the 8km/h condition accuracy (mean error) was -70mm (AP axis), 23mm (ML axis), -95mm (vertical axis). Precision (error standard deviation) was 10mm, 17mm and 5mm for the three axes with correlation coefficients of 0.96, 0.28, 0.83. Average cycle-by-cycle range of motion (RoM) of relative CoM displacement had a precision of 6.7mm, 2.7mm, 3.5mm.

DISCUSSION

The proposed method allowed computing relative CoM movement for the AP and vertical axes with high precision. The high correlation and precision demonstrated that arm movement can be measured. Nevertheless, due to limitations of the used body model only RoM values and curves should be

used instead of absolute CoM values.

CONCLUSION

The study showed that inertial sensors can be used for measuring relative CoM displacement in V2 skating. However, before using the system a validation on a large population is required.

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