1 B. Knünz, W. Nachbauer, M. Mössner, K. Schindelwig, and F. Brunner, Track Analysis of Giant Slalom Turns of World Cup Racers, 5th Annual Congress of the European College of Sport Science, 2000

Reference: B. Knünz[1], W. Nachbauer[2], M. Mössner[3], K. Schindelwig[4], and F. Brunner[5], *Track Analysis of Giant Slalom Turns of World Cup Racers*, Proceedings of the 5th Annual Congress of the European College of Sport Science (ECSS) (Jyväskylä, FI) (J. Avela, P.V. Komi, and J. Komulainen, eds.), University of Jyväskylä, FI, 2000, p. 399.

Introduction

The track of a perfect giant slalom turn is meant to show no skidding. There are only a view publications dealing with trajectories in different disciplines of Alpine ski racing e.g. Förg-Rob and Nachbauer [1]. However, there are no studies giving information on the amount of skidding during a turn. The purpose of the study was to evaluate the carving and skidding behavior during giant slalom turns of elite skiers.

Method

Three Alpine world cup racers (R1, R2, R3) performed giant slalom turns on a course with 8 open gates on an approximately plain slope of 16° inclination. The snow conditions were hard packed. Control points were distributed along the path of the skier and geodetically surveyed (Nachbauer et al., [2]). The subjects were recorded by a video camera at 50 frames/s. In the laboratory 4 points of each ski and at least 8 control points were digitized per frame. The position of the ski points on the slope were computed using the 2d DLT-method. 3d coordinates of the ski points were obtained from the 3d model of the slope. The data were smoothed using smoothing splines (Woltring [3]). For this study five runs were processed. Analyzed parameters are shear off area per cm track length (A) and the angle of the ski relative to the moving direction (α). These parameters were calculated for the inner and outer ski for two turns of each run (T1, T2). The beginning and the end of the turns were determined by the edge change.

Results

Fig 1 shows the track of racer R1. The markers on the track indicate the edge changes. Turn duration for T1 was 1,48 s and for T2 1,40 s. For T1 A was 20 cm^2 for the inner ski and 9 cm^2 for the outer ski. For T2 A was 9 cm^2 for the inner ski and 5 cm^2 for the outer ski.

Fig 2 shows the angle (α) of the ski relative to the traveling direction of skier R3. The vertical line indicates the edge change. For T1 peak values of equal 7° for

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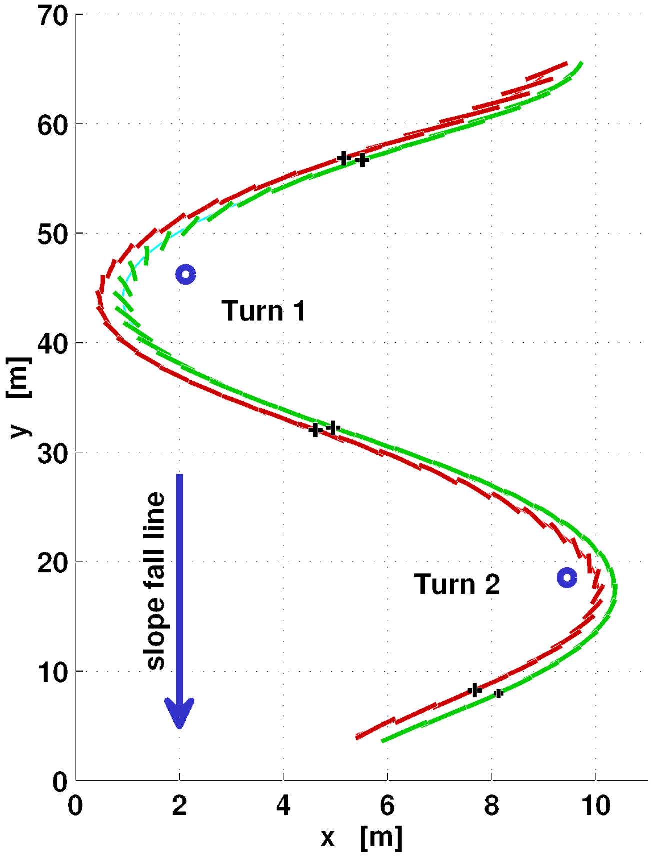

Fig. 1: Track of racer R1.

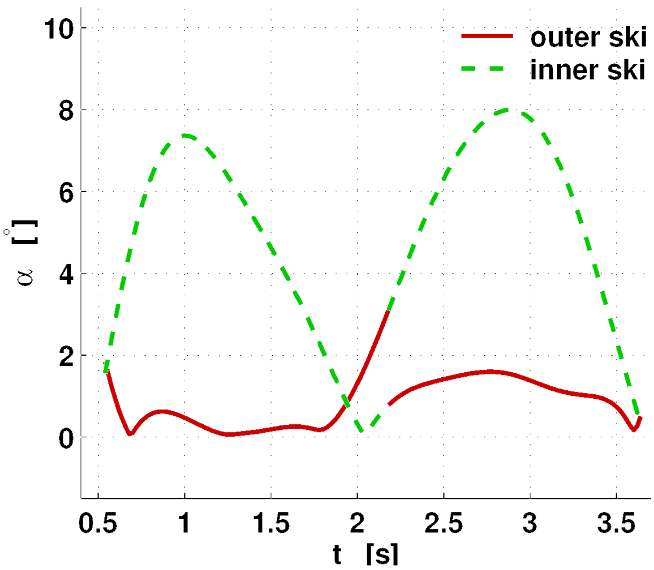

Fig. 2: Angle of the ski relative to the traveling direction (α) of racer R3.

the inner ski and about 1° for the outer ski were observed. For T2 values up to 8° for the inner and 2° for the outer ski were calculated.

The mean value for the turn duration was 1.47 s, the track length was 28.5 m, and the velocity was 19.4 m/s. The turn radius was approximately 20 m. The range of the analyzed parameters in the 5 runs were as following: For T1 A varied between 10-19 cm^2 for the inner ski and 2-10 cm^2 for the outer ski. For T2 A showed a variation of 4-20 cm^2 for the inner ski and 4-5 cm^2 for the outer ski. For T1 and T2 peak values for α were between $2 - 12°$ for the inner ski and $1 - 8°$ for the outer ski.

Discussion

Even highly skilled world cup racers do not purely carve giant slalom turns. There was considerably more skidding for the inner ski than for the outer ski. The amount of skidding differs between the subjects and within their runs. Skidding occurs both in the initiation and the steering phase of the turn. During the unloaded part of the initiation phase this might be a technique used by skilled racers. In the steering phase it results in increased friction and, hence, in a velocity reduction. In order to verify these statements more runs have to be analyzed.

References

[1] W. Förg-Rob and W. Nachbauer, *Use of Spline-Functions in the Smoothing of Film Data for Slalom Ski Racers*, International Journal of Sport Biomechanics **4** (1988), 166–177.

[2] W. Nachbauer, P. Kaps, B.M. Nigg, F. Brunner, A. Lutz, G. Obkircher, and M. Mössner, *A Video Technique for Obtaining 3-D Coordinates in Alpine Skiing*, Journal of Applied Biomechanics **12** (1996), 104–115.

[3] H.J. Woltring, *A Fortran Package for Generalized Cross Validatory Spline Smoothing and Differentiation*, Adv. Eng. Software **8** (1986), 104–107.