

TRACK ANALYSES OF GIANT SLALOM TURNS OF WORLD CUP RACERS

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INTRODUCTION

The track of a perfect giant slalom turn is meant to show no skidding. There are only a few publications dealing with trajectories in different disciplines of Alpine ski racing e.g. Förg-Rob/Nachbauer (1988). 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 behaviour 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., 1996). 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 digitised 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, 1986). For this study five runs were processed. Analysed parameters 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 travelling direction of skier R3. The vertical line indicates the edge change. For T1 peak values of α equal 7° for the inner ski and about 1° for the outer ski were observed. For T2 α 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 analysed parameters in the 5 runs were as following: For T1 A varied between $10\text{--}19 \text{ cm}^2$ for the inner ski and $2\text{--}10 \text{ cm}^2$ for the outer ski. For T2 A showed a variation of $4\text{--}20 \text{ cm}^2$ for the inner ski and $4\text{--}5 \text{ cm}^2$ for the outer ski. For T1 and T2 peak values for α were between $2\text{--}12^\circ$ for the inner ski and $1\text{--}8^\circ$ 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 analysed.

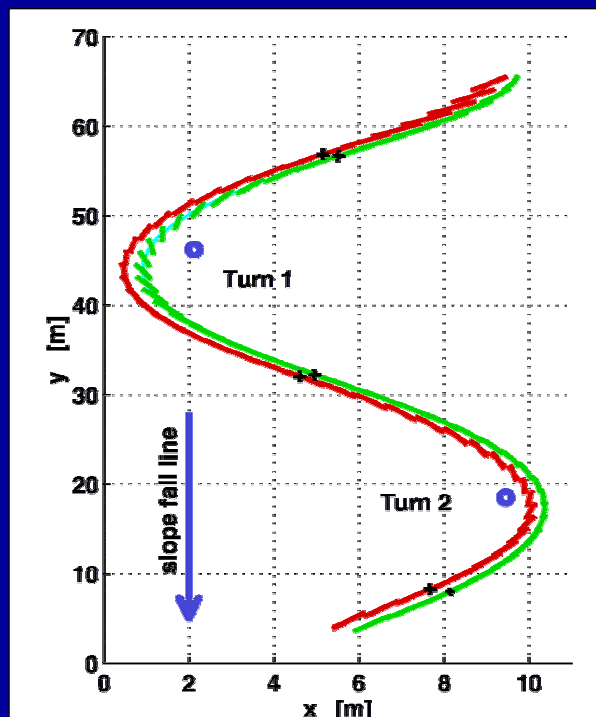


Fig. 1. Track of racer R1

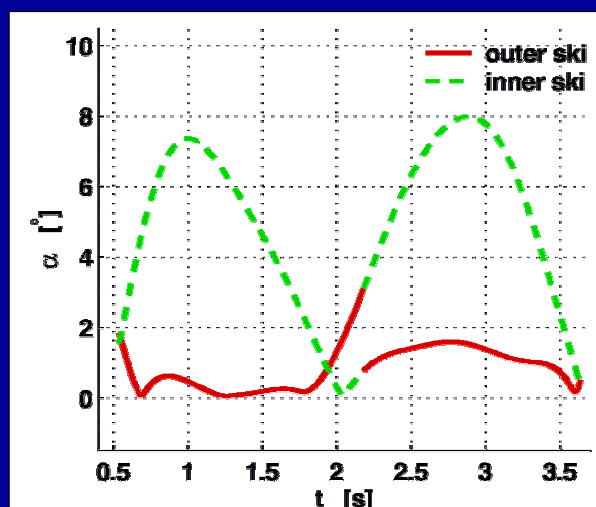


Fig. 2. Angle of the ski relative to travelling direction (α) of racer R3

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