

GEOMETRY AND RUNNING OF THE ALPINE SKI FIS WORLD CUP GIANT SLALOM PART ONE - GEOMETRY

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The aim of this paper is the presentation of the geometry of the alpine ski giant slalom at the highest world level in order to calculate the obtained time by videorecording velocity and acceleration of running.

KEY WORDS: alpine skiing, giant slalom, fis world cup, geometry

INTRODUCTION: In alpine skiing the role of a coach is a difficult one. This is due in part, to the fact that during the competition he would be unable to observe the athlete for the entire track, regardless of the position he chose, because of the extensive terrain. Before the competition the organizing committee provides data only on general description of the course, i.e. the length of the slope (measured usually without snow) and few data on the incline of the slope. Unfortunately, no data on geometry of gates is supplied to the coaches. During the competition the time of running of the entire course and of one or two segments of the course are displayed. These data do not provide sufficient information with which to evaluate adequately an athlete's performance on the course.

Possession of detailed data on the geometry of the poles setting and on the time of the running between them would allow the coach to more accurately assess the performance of the skier on the course, i. e. what velocity and acceleration he had achieved between the gates. On this basis it would be possible for the coach to provide better evaluation of the tactics involved in running.

Up to 1990s the investigations on slalom skiing were performed on a small fragment of the course, i.e. 2 - 3 gates (Cotelli and Cotelli 1979, Nachbauer 1987). The complete alpine skiing course, e.g. that of the giant slalom (GS) can be presented with the help of the following quantities: distances between turning poles of the gates, angles of deviation, angles of incline (Erdmann 1995) - Figure 1. Using those quantities Erdmann and Giovanis (1997) and Giovanis (1998) presented the geometry of the GS of the Greek Championships organized in Naousa.

The aim of this paper is the presentation of the geometry of the alpine ski giant slalom at the highest world level.

MATERIAL AND METHODS: In this study, the geometry of men giant slalom's setting at the Alpine Ski World Cup of the International Ski Federation (FIS) in Kranjska Gora (Slovenia) and Saalbach Hinterglemm (Austria) of the 1997/1998 season (January 1998) was achieved. In both cases two settings of GS were investigated.

In the work of Erdmann and Giovanis (1997) and of Giovanis (1998) the position of GS poles was obtained by using geodetic theodolite. In this work, triangulation methodology was used to obtain distances between turning poles of GS gates - Figure 2. Sides' lengths of adjacent triangles were measured. The turning poles made apexes of triangles. The measuring tape was used to measure all inter-gate distances.

Using data on lengths of triangles' sides angles of deviation to the right hand side and to the left hand side, measurements on the giant slalom course were calculated. The incline angles in Kranjska were obtained from the video picture, recording on the monitor's screen, the level and two turning poles of the neighbouring gates. In Saalbach, for the first setting the above method was used, and for the second setting incline angles were measured with the help of goniometer with the sights and with the plumb-line.

RESULTS: The total GS length, i.e. the sum of all inter-gate distances, was 1148.59 m in Kranjska and 1455.69 m in Saalbach (means of two runs) - Figure 3 and 4. These lengths were by 26.8 and 55.5 % more than in Naousa, respectively. Mean inter-gate distances were

(\pm S.D.) 23.50 ± 3.87 m in Kranjska and 27.47 ± 5.62 m in Saalbach (minimum - maximum data: 10.87 and 30.42 m in Kranjska, 11.56 and 36.48 in Saalbach). In Naousa mean and S.D. data were: 26.01 ± 5.03 m. These results demonstrated that longer inter-gate distances increased the speed of running.

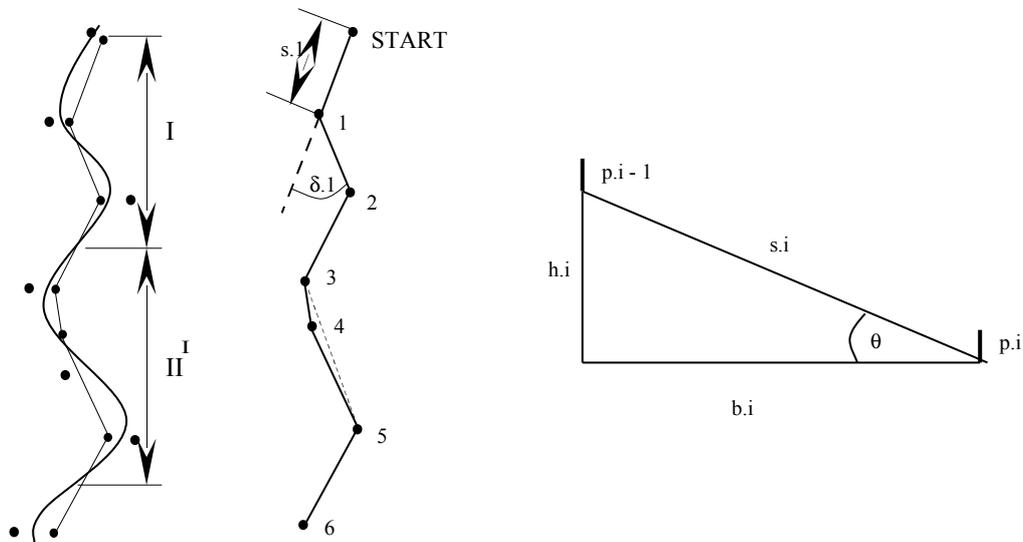


Figure 1 - Parameters of giant slalom setting: p - pole; inter-gate distances: s - on the slope, b - horizontal, h - vertical; θ - angle of incline; δ - angle of deviation; 1..6 - gate numbers; I, II - cycle numbers (gates 3 and 4 were run with one turn).

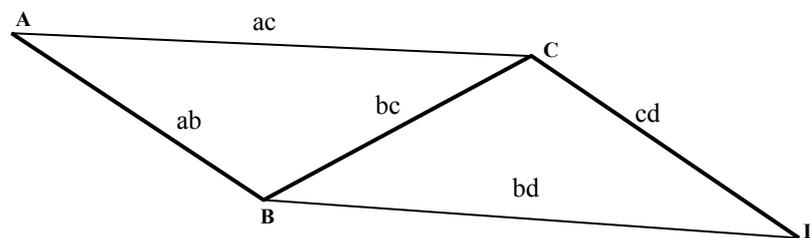


Figure 2 - Triangulation method: ab, ac, bc, bd, cd - distances measured, i.e. sides of triangles.

Mean angles of deviation were 29.6 ± 11.0 degrees in Kranjska, 28.8 ± 13.2 degrees in Saalbach (minimum - maximum data: 1 and 62.5 degrees in Kranjska, 0 and 52 degrees in Saalbach). In Naousa it was: 24.8 ± 12.3 degrees. Bigger angles of deviation slow down running. Mean incline angle was 16.8 ± 5.4 degrees in Kranjska and 13.7 ± 6.3 in Saalbach (minimum - maximum data: 3 and 29 degrees in Kranjska, -3 and 28 degrees in Saalbach). In Naousa it was: 17.9 ± 3.4 degrees. Mean incline angle in Saalbach of a small amount was due to a fragment of the slope where skiers ran up-hill for a short period. The setting of gates at this particular fragment had small deviation angles which enabled maintaining velocity. The course in Naousa of 36 inter-gate distances has been run with 15.5 cycles, in Kranjska of 49 inter-gate distances with 22.5 cycles and in Saalbach of 53 inter-gate distances with 23 cycles. There were always a few sets of two gates (one open and one closed gates, i.e. situated perpendicular and parallel to the direction of a course), taken by one turn. In Naousa there were two examples of this, in Kranjska three and in Saalbach five sets. Also there were differences in the ending of courses. In Naousa the last three gates were taken with one turn, while in Saalbach the last two gates and in Kranjska only one last gate was taken with one turn.

DISCUSSION: The data of GS setting geometry and on running time (time was obtained with the help of video technique) will enable obtaining values of velocity and acceleration / deceleration. These data can be utilised for the evaluation of tactics of running. Aschenbrenner (1998) gave a description of GS running of the best Olympic skiers based on inter-gate times. Those who were best after the first one-fourth of the course were not the best ones at the end, due to an error in the basic tactics of running. Erdmann and Giovanis (1998) and Giovanis (1994) presented incidents in GS alpine skiing, i.e. falls, running over a pole, missing a gate. Wrong tactics, e.g. accelerations that were too great and decelerations, especially at the beginning of the run, is a common cause of incidents. These conclusions were obtained for Greek skiers. Further investigations will describe the same problems for the best of the world's skiers.

One of the problems inherent in alpine skiing is a difficulty with comparison of different courses set on the same slope and also on different slopes. With data obtained on the geometry of a giant slalom or any other alpine ski discipline and on the velocity of running by the best competitors, potentially coaches and officials will be able to provide coefficients dealing with a character of the slope and with a particular setting of gates. It will be also possible to point out wrong setting of gates. With the data on gates setting it would be possible to change incorrect setting of gates in order to prevent skiers from being involved in accidents (Erdmann 1997).

During the coverage of a sport event by television broadcasting institutions, it is usual for some data of an event to be shown. Examples of these are as follows: an overall length of a slope, a difference of start and finish levels and the intermediate and end times. In order to provide the spectators and tv-viewers with more information, data on the geometry of a GS and on-line data on the gate by gate running time could be utilised. It is possible, using computer data, to show as an inset to the television screen the position (using two colour dots) of a current running skier and the best skier of a particular competition. This could be done as a picture of a side profile shown along inter-gate distances (similar to that presented in Figure 4), or as a grid (similar to a ladder), shown at the side of a tv screen, where two dots moving from the top to the bottom would show the position of the current and the best skiers. It is also possible with the visualization of the mean inter-gate velocities of the skiers, for the current and the best performance to be seen simultaneously. For example, the following velocities could be visualized for comparison: a view from the start to the previously seen gate and the second image of the immediately elapsed inter-gate distance. There is a potential problem of transferring the computer time data of the current seen skier. This could be done by an operator pushing the appropriate key on the key-board when a skier passes a pole, or by placing near the GS pole, a magnetic field sensor of the passing skier and in this way transferring the data to the computer (Erdmann 1997).

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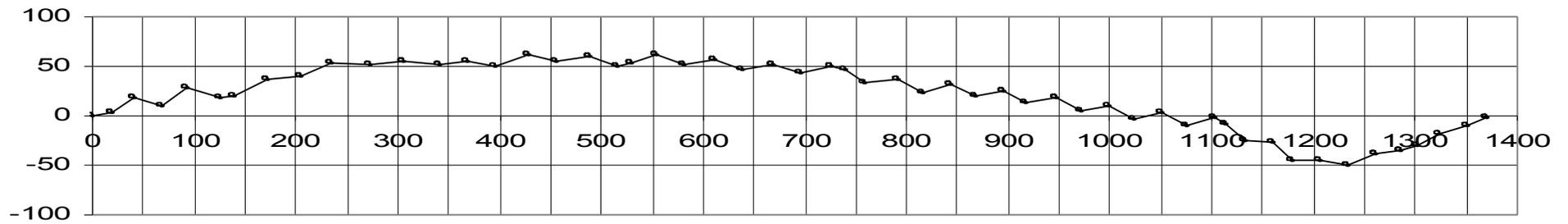


Figure 3 - Inter-gate distances of Saalbach GS (2nd run) measured on the slope.

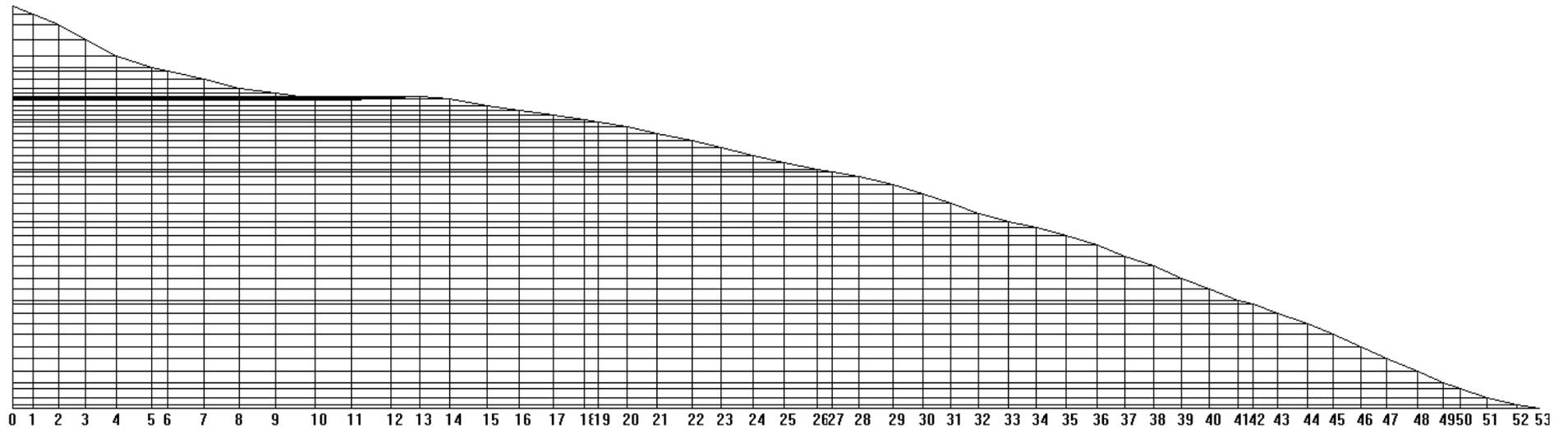


Figure 4 - Side profile of Saalbach GS (2nd run) shown along inter-gate distances.