C42 Trajectory Analysis Applied to Snowboard Terrain Park Crash Investigation

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After attending this presentation, attendees will understand some principles of trajectory path as a function of inrun (take off ramp) angles, out run (landing ramp), and initial speed for a snowboard terrain park jump features.

This presentation will impact the forensic science community by providing a clear analytical model which can be used to calculate the take off speed of a user of a ski jump based on measurements of the snow surface take-off angle, snow surface landing angle, and the distance the user was not in contact with the snow surface.

This presentation will also show how it is possible to calculate the initial speed of a snowboarder based on the takeoff angle, landing angle, and total airborne distance as measured through the distance on the snow surface between the take off point and the appearance of ski tracks on the outrun snow surface where the jumper landed. The length of the gap between take off point and landing point is easily measured along the snow surface. Take off angle and landing ramp angle are easily measured using a digital level. Using the three parameters of take off angle, landing slope angle and the distance the skis are not in contact with the snow it is possible to calculate the path of the trajectory including the maximum height above the snow as well as the vector velocity components at landing and the time period of the jump. Understanding the velocity of the jumper at the landing area is a fundamental aspect of creating good jump design

In regard to the investigation and reconstruction of terrain park accidents it will be shown how the initial speed of the user can be calculated based on the physical parameters of the jump and the distance of the jump.

This presentation will provide a simple analytical tool that could be used by the designers of snowboard terrain parks as an aid in designing jump features so that the in-run speeds and angles are coordinated with the landing ramp so that for expected take-off speed ranges the users of the features will not “overshoot” the landing ramp.

The author will present a case study in which a terrain park feature in-run was modified following reports of users (snowboarders) overshooting the landing, due to excessive speed at take off. Instead of modifying the in-run to control the take off speed of the jumpers, the park designers decided to increase the steepness of the take off ramp. The intent was to increase vertical projection of the jumpers and reduce the horizontal projection down the hill.

The modifications resulted in a greater horizontal projection and “overshooting” of the landing ramp by the users-not what was intended. Also, increasing the steepness of the take off ramp created more counter rotation (as in back flip) to the user. The problem with overshooting the landing area is that the user then lands on a “flatter” part of the ski hill which results in a harder landing. The injured user had used the jump the day before the modifications without incident. The jump take off angle was modified during the evening hours when the terrain park was closed. During first use of the jump the next day the snowboarder rotated rearward approximately 180 degrees in the air and overshot the landing ramp landed on his head.

The ramifications of the trajectory of the jump modifications will be shown to be contrary to what the jump modification was intended to show.

Trajectory, Snowboard, Jump

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