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BI-SECTION SKI MODEL FOR CARVING TURN

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1. Introduction

We propose a kinetic model for skis in carving turn. In our model, a ski in carving turn is consists of two sections, one is skidding section which is anterior part of the ski, and the other is carving section which is posterior part of the ski. Skidding section receives snow cutting force from its edge and also receives snow impact force from its sole [Tada98]. The holding condition of Merchant theory in machining must be satisfied in carving section [Brown00].

2. Bi-Section Model for Carving Turn

A ski has flexure while turning according to its elasticity and centrifugal force (fig.1a). For simplicity, we separate turning ski to two sections, Skidding section and Carving section, and two sections are connected with an elastic hinge (fig.1b). Elasticity of the hinge stands for the total elasticity of the ski. Turning force Ft is defined as a sum of the turning forces of two sections,

$$Ft = Fts + Ftc \quad (1)$$

where Fts stands for the turning force of skidding section, and Ftc for the turning force of carving section. Fts is divided to snow cutting force Fc and snow impact force Fi.

$$Fc = \tau PLs / \tan(\theta/2) \quad (2)$$

$$Fi = \rho PLsWV^2 \sin\varphi \quad (3)$$

Where τ stands for sheer strength of snow, P for penetration depth, Ls for the edge length in skidding section, θ for edging angle, ρ for the snow density, W for ski width, V for velocity, and φ for steering angle. Carving must satisfy the holding condition of merchant theory, such as

$$Ftc \le \tau PLc / \tan(\theta/2), \quad (4)$$

where Lc stands for the edge length in carving section.

3. Concluding Remark

In our model, the side cut effects to increase the edge length in skidding section Ls, so that the deeper side cut can generate more turning force. This consideration is consistent with our skiing experience. The effects of other elements, such as flex and velocity, will be evaluated.

References

[Tada98] Tada,N. and Hirano,Y.," Experimental determination of snow resistance forces acting on a turning snow ski", Proc. of the 2nd International Conf. on the Engineering of Sport, Blackwell Science, Oxford

[Brown00] Brown,C., "Modeling Edging Forces in Skiing using Merchant's Theory for Metal Cutting", http://users.wpi.edu/~brown/machining/

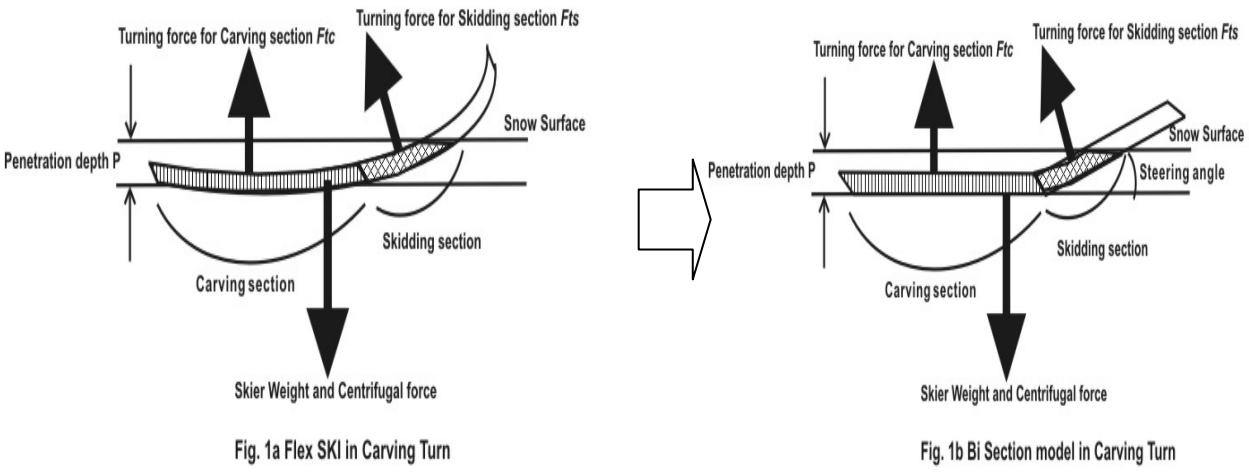

Fig1. Ski Model for Carving Turn