# A KINEMATIC AND DYNAMIC ANALYSIS OF ELITE ALPINE SKIERS

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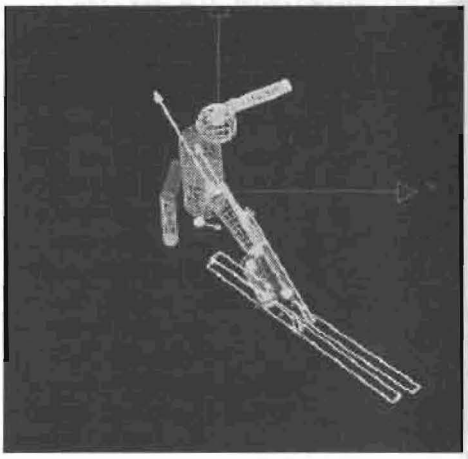
**INTRODUCTION:** The knowledge of the internal forces and torques acting on a joint during a physical activity as well as a clear description of the motion performed by an elite athlete is of top most interest for rehabilitation, teaching or training purposes. Nevertheless, the motion of the athletes can be strongly affected by the evolution of the equipment design. For example, great changes in terms of angular motion and ground reaction have been revealed in alpine skiing when comparing conventional and carving turns (Yoneyama, 2000). More recently, Müller and Schwameder (2003) have carried out a comparative study between conventional and carving ski turn based upon kinematics, plantar pressure and EMG records. Coupling 3D video analysis and forceplate acquisition, the present work aims at recording the displacements of whole body segments as well as ground reaction in order to analyze the turning motion of elite alpine skiers.

**METHODS:** Three elite alpine skiers (2 males and 1 female; age, 24 ± 4 years; mass, 79 ± 12 kg; height, 1.74 ± 0.06 m) participated in this study. Video data were collected with five DV cameras (sampling frequency: 50 Hz) located around the track. The ground reaction components (3 forces and associated torques) were measured under the left and the right ski boots with Kistler forceplates (sampling frequency: 600 Hz). The whole space measurement was 22 m long, 4 m width and 2.5 m high on a mean plain slope of 22° inclination with 3 gates for slalom. 3D Kinematics of segments were calculated using the Direct Linear Transformation algorithm (Abdel-Aziz and Karara, 1971) from the five video inputs using the optical motion analysis system Simi Motion.

**RESULTS:** First results have shown that i) the loadings of inner and outer skis are nearly equal: they produce synchronous and identical absolute maximum force during the turning motion ii) a flight/suspension phase (negative values on vertical forces for both skis) appears at the end of the turning motion. Moreover, this flight time is associated with a crossing between the trajectories of the whole body center of mass and those of the skis. This crossing denotes the beginning of the initiation phase of the turning motion.



**DISCUSSION:** From the analysis of the kinematics and dynamics we expect to demonstrate that elite alpine skiers extensively use the mechanical properties of their skis to increase their performance.

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