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Lift mechanics of downhill skiing and snowboarding QIANHONG WU, Villanova University, YESIM IGCI, Princeton University, YIANNIS ANDREOPOULOS, SHELDON WEINBAUM, The City College of New York — A simplified mathematical model is derived to describe the lift mechanics of downhill skiing and snowboarding, where the lift contributions due to both the transiently trapped air and the compressed snow crystals are determined for the first time. Using Shimizu's empirical relation to predict the local variation in snow permeability, we employ force and moment analysis to predict the angle of attack of the planing surface, the penetration depth at the leading edge and the shift in the center of pressure for two typical snow types, fresh and wind-packed snow. We present numerical solutions for snowboarding and asymptotic analytic solutions for skiing for the case where there are no edging or turning maneuvers, which shows that approximately 50% of the total lift force is generated by the trapped air in the case of wind-packed snow for snowboarding and 40% for skiing. For highly permeable fresh powder snow the lift contribution from the pore air pressure drops to $< 20\%$. This new theory is an extension of the series of studies on lift generation in highly compressible porous media.

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