Master thesis project proposal:
Simulation-driven development of improved alpine ski helmets by Bliz

In contrast to 20 years ago, helmets are today widely accepted in alpine skiing to protect against impact injuries. In fact, since helmets were introduced as mandatory in downhill racing, the number of head injuries have dropped significantly. (would be nice with some numbers). However, improvements are still necessary, both in order to further protect the skier (as speeds are increasing) and to look for more sustainable materials in the design. In addition, for more rapid prototyping, and to enable more efficient screening of various design solutions, helmet deign needs to transition more towards simulation-driven product development.

In the current project, the ambition is to take the first steps towards a simulation-driven design procedure of helmets for alpine racing. The aim is to find an improved design for absorbing impact energy, and to investigate the potential for transferring to bio-sourced materials (natural fibres and or bio-sourced polymers).

The first task of the project is to set up an FE-model of an impact load case of an existing ski helmet, including both the outer fibre-reinforced composite skin and the internal energy absorbing foam, and to try to validate this model against existing experimental data from impact testing. With this model at hand, the task will then be to evaluate different design concepts for improving the impact absorption properties of the helmet and/or (also depending on the interest of the student) to study the effect of changing into more sustainable material solutions.

The project is a collaboration between Chalmers Sports & Technology, the Division of Material and Computational Mechanics and Bliz, a manufacturer of sports equipment for cycling and cross-country and alpine skiing. The work will be conducted at Chalmers, in close collaboration with Bliz who will provide experience, material data and experimental data from impact tests.

We are now looking for interested students with documented knowledge in solid and composite mechanics, the finite element method and material mechanics. You need to be motivated and self-propelled and to be able to take own responsibility for the progress of the project. Experience of polymers and polymer foams is a plus but not a requirement. During the project, you will be offered advice and support from experienced researchers in at Chalmers as well as from a company that is very active in the alpine world cup.

Interested, please contact **Martin Fagerström**, martin.fagerstrom@chalmers.se (examiner)

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