

Master thesis project proposal: Finite element modelling of an ice hockey slap shot (Bauer)

Ice hockey sticks are constantly under development. Today, these are mainly made from fibre reinforced polymeric materials (such as carbon fibre composites). The use of these lightweight materials has led to that sticks have increased in stiffness while reducing in weight, while maintaining a high level of durability and impact resistance.



The proposed master thesis project aims to support the hockey stick development at Bauer in Canada, by developing a finite-element based modelling approach to analyse a hockey stick during a slap shot. The goal of the project is to create a finite element model in ANSYS Workbench, with aid of Ansys Composite PrePost (ACP) and the built-in LS-DYNA solver, that is able to predict a representative motion of the stick (including the blade), the forces on the ice and in interaction with the puck, but also the stress distributions in the shaft and the blade.

The results from the FE-model to be developed in this master thesis will also be shared with a collaborative project at the University of Sherbrooke, where researchers currently are developing and sizing a robot aimed for executing slap shots. Thus, there will be a close collaboration both with hockey stick designers at Bauer, as well as with researchers at the University of Sherbrooke.

As input, Bauer will provide a detailed ANSYS FE-model (built using ACP) of a modern hockey stick, and researchers at University of Sherbrooke will provide motion capture data and high speed video taken from “on ice” slap shots.

To be more precise, the task of the project team will be to:

- In ANSYS ACP develop and validate an FE-based simulation model of an ice hockey slap shot, starting from a base FE-model provided by Bauer.
- Define a procedure for how motion capture data and high speed video from real slap shots can be utilised as input to defining realistic boundary conditions of the FE-model.
- Interact closely with both the hockey stick developers at Bauer and researchers at the University of Sherbrooke, to aid the development of a slap shot robot currently under development.
- If there is time, look at stress distributions in the stick to propose more durable designs.

The project is a collaboration between Chalmers Sports & Technology, the Division of Material and Computational Mechanics Bauer and the University of Sherbrooke. The work will be conducted at Chalmers, in close collaboration with engineers at Bauer and researchers in Sherbrooke who will provide experience for hockey stick design, a base FE-model, material data as well as motion capture data from slap shots.

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. 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 world of hockey!

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