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The Ice Hockey Research Group Braves the Ice with Vicon to Study the Effects of Hockey

Image courtesy of IHRG

For Canadians, hockey is more than just a pastime – it's a way of life. From a young age, many Canadians learn to skate. It can become as natural as walking to some, but the reality is that skating – and especially hockey – can take its toll.

Over the years, there have been several attempts to document the physical effects that skating and hockey can have on the human body. The question is, how do you conduct delicate, scientific research in the cold, on ice?

VICON | Case Study

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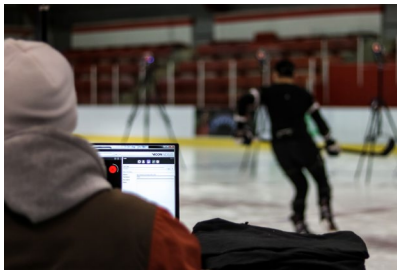

The Ice Hockey Research Group (IHRG) working out of McGill University in Montreal, Canada, found the answer to exactly that question when it turned to Vicon.

Mocap on Ice

The IHRG was created to evaluate the ergonomic and mechanical function of skates, sticks and protective equipment – in respect to performance and safety when used by people on the ice. A research partnership with Bauer Hockey Ltd. and the Natural Science and Engineering Research Council of Canada (NSERC) provides both financial and testing materials, which has led to the development of a unique graduate biomechanics program focused on how people use and react with ice hockey equipment.

In 2014, Dr. David J. Pearsall, IHRG Director and Associate Professor of Kinesiology and Physical Education at McGill University, decided to risk it and try Vicon's motion capture (mocap) cameras and software, equipment that carried a reputation for durability. The IHRG team began by creating a synthetic ice rink in order to get a sense of where the cameras needed to be placed and positioned. Once they were confident of their configuration, they prepared for the real thing.

"The Vicon setup on the ice replicated the in-lab configuration on a larger scale," explains Philippe Renaud, IHRG Research Assistant. "This included extra safety measures, such as added weights to tripods for greater stability, and suspended cable bridging over the skating ice path, plus special gloves to type on the computer in the cold. It worked out really well."

Hitting the Ice

The first on-ice study that the IHRG conducted compared the skating start biomechanics of male ice hockey players with different levels of skill and experience. Since then, the IHRG completed and published a second study, authored by Jaymee Shell, a masters graduate student at McGill University at the time. Shell studied the biomechanical differences between male and female players to identify potential factors that may be implicated in lower body injuries.

"As reported in prior running research, frontal plane differences between genders in hip and knee movements exist," said Shell. "We wanted to look at male and female ice hockey players and see if similar lower body kinematic differences existed or were greater."

The indoor ice rink's cold temperatures and high humidity were challenging for the cameras. There was the fear that the reflection from the ice would obscure marker tracking, but the equipment had no issues. The study represents a major achievement in 3D mocap, as the team was able to expand its range and calibrate a large 15m × 3m × 2m capture volume on the ice to record skating kinetics, with high intra-trial reliability. They did run into an issue, but the team was able to turn to Vicon application engineer John Porter, who Shell says, "saved her project."

"It wasn't the cameras' fault at all – the cameras did exactly what they had to do," she says. "But having the Vicon support through the study was really invaluable. I can't praise the support team enough for what they did. I might still be labeling my data if it weren't for them!"

Following Shell's publication, the IHRG decided to incorporate some of her methods and include female athletes in more of its studies.

Speeding Ahead

Soon after Shell completed her study, IHRG upgraded their system to include a Vantage and Vero optical camera, bringing the total number of cameras to 18. Soon after the upgrade, the IHRG expanded their studies to include puck shots, which brought with it the added risk of a puck bouncing back and hitting a camera. To compensate, target nets were placed far enough back out of the capture area to reduce the risk of any collisions.

The team later added a Bonita camera alongside the Vantage to overlay the video with stick figure motions, making it easier to communicate their findings with others. EMG and force sensors were later introduced, all synchronized through Vicon software.

"To date, we've achieved a 15-meter FOV over the ice surface," Pearsall explains. "In skating, when you're at full speed, you can do 15 meters in two strides. As well, the increased pixel count and resolution of the Vantage cameras helps maintain the resolution needed to track the full-body marker set."

The IHRG's success has also led to studies in other fields beyond hockey, including working with groups to better understand how footwear performs on snow and ice. With the help of the Vicon cameras, the team is able to collect more data than ever before, which could prove to be invaluable to people that consider the ice a second home.

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