# MAE Departmental Seminar

**Time/Location**: March 1, 2019 at 1:30pm in ME3124

**Title**: The use of decoupling structures in helmet liners to reduce maximum principal brain tissue strain for head impacts


## Abstract:

The primary goal of the American football helmet has been protection of players against skull fractures and other traumatic brain injuries (TBI). TBI can result from short, high magnitude linear impact events typical of when the head impacts a hard surface. The modern helmet, which has evolved and become well designed to mitigate TBI injuries, does not offer sufficient protection against injury such as concussion, and the incident rate remains high in sport. Researchers speculate rotation of the head leads to shear strain on the brain tissue, which may be the underlying mechanism of injury leading to concussive type injuries. This has led researchers to investigate new liner materials and technologies to improve helmet performance and include concussive injury risk protection by attempting to address rotational acceleration of the brain. To improve current football helmet designs, technology must be shown to reduce the motion of the brain, resulting in lower magnitudes of dynamic response thus reducing maximum principal strain and the corresponding risk of injury. Recent research has studied the use of decoupling liner systems in addition to the existing liner technology, to address resultant rotational acceleration. However, none of this previous work has evaluated the results in terms of the relationship between brain motion, tissue strain, and injury risk reduction. This thesis hypothesises the use of decoupling strategies to reduce the dominant coordinate component of acceleration in order to decrease maximum principal strain values. The dominant component of acceleration, defined as the coordinate component with the highest contribution to the resultant acceleration for each impact, is a targetable design parameter for helmet innovation. The objective of this thesis was to demonstrate the effect liner strategies to reduce the dominant component of rotational acceleration to decrease maximum principal strain in American football helmets.


## Speaker Bio:

After 7 years as a professional engineer in the oil and gas industry in Calgary, AB, Dr. Karen Taylor completed her PhD (2018) at the University of Ottawa studying the influence of decoupling structures in helmet liners to reduce maximum principal brain tissue strain for head impacts. Upon completion, she joined the Department of Mechanical and Aerospace Engineering at Carleton University as a post doctoral fellow to work within the Impact Research Laboratory continuing in the area of head impact mechanics, helmet testing, and helmet design. Dr. Taylor previously completed a M.A.Sc. (2006) and B.A.Sc. (2003) in Mechanical engineering at University of Ottawa as well as a B.Sc. (1998). In Exercise Science – Athletic Therapy from Concordia University.