MAE Departmental Seminar

Time: 1:30pm
Date: December 6, 2017
Room: ME3124

Title: Continuous X-ray Digital Image Correlation to Resolve Dynamic Deformation and Strain Fields of Internal Planes

Abstract: Material characterization and deformation analyses are critical to engineering design. Digital Image Correlation (DIC) is a widely used full-field surface displacement and strain measurement tool. A high-contrast pattern such as black speckles on a white background is applied to the surface, then pixel subsets are compared in a series of consecutive images reflecting different stress states to determine displacement and strain fields. The speckle pattern is designed to maximize Signal-to-Noise Ratio (SNR), increasing DIC accuracy.

DIC can be extended to resolve strain fields of optically inaccessible internal planes using X-ray cineradiography. Contrast generating markers must be embedded into the bulk specimen as the radiographic equivalent of the black and white speckles used in optical DIC. Proper material selection for the embedded markers is critical for DIC accuracy. X-ray attenuation is determined by the probability of photon-atom interaction, therefore heavier elements and more dense materials have lower X-ray penetration. To maximize contrast, tin or lead are often embedded in elastomers as radiographic contrast markers. However, under impact loading conditions it is believed that density and stiffness of these markers affect bulk material properties. Therefore, marker composition must be selected to provide sufficient contrast to not adversely affect the specimen's dynamic response. An alternate approach to marker design in elastomers is presented where the speckles are pre-cast using the same bulk material doped with heavier elements to better represent the expected dynamic response while considering the effects on signal-to-noise ratio.

Speaker's Short Bio: Stéphane Magnan studied mechanical biomedical engineering at the University of Alberta before coming to Carleton to study deformation of elastomeric tissues using high-speed X-ray cineradiography. He is currently a second year MASc student with Professor Oren Petel and is investigating the deformation of optically inaccessible planes of irregular surfaces using Digital Image Correlation.