

## PhD position

- **Project Title:** Nonsmooth Modal Analysis
- **Location:** McGill University, Department of Mechanical Engineering
- **Research Area:** Vibrations, Nonlinear dynamics & Contact Mechanics
- **Start Date:** January 1, 2014
- **Deadline to Apply:** Not specified
- **Position Description:**

This research project proposed, for PhD candidates, is in the area of vibration modeling and analysis of mechanical systems undergoing unilateral contact and dry friction conditions. Such mechanical systems are said to be nonsmooth because the solution field may be non-differentiable and/or discontinuous. To attack such class of problems, it is suggested to merge modal analysis to unilateral contact mechanics: the targeted new area of research could be generically named "Nonsmooth Modal Analysis".

Linear modal analysis is the archetypal tool in vibration analysis. An in-depth understanding of forced structures relies on the study of the underlying autonomous system which feature families of orbits in the vicinity of a fixed point. These families of orbits lie on invariant flat subspaces such that motions which start on them remain on them for all time. This approach can be extended to smooth nonlinear systems for which it can be proven that the invariant property persists locally on curved manifolds. Nonlinear modes of vibration are such that large responses are expected around their respective frequencies that cannot in general be predicted by linearized models. Extension to nonsmooth system is challenging and modeling nonsmooth systems results in serious conceptual, mathematical and computational difficulties. This mainly stems from the combinatorial nature of such problems which solution should satisfy equalities as well as inequalities.

Corresponding areas of research are: weak formulations in time, wavelet functional analysis, contact mechanics, discontinuous Galerkin techniques, finite element analysis, time-marching approaches.
- **Desired Skills:**

Numerical analysis; finite element analysis; functional analysis; optimization.
- **Documents Required:** CV, statement of research interests, and a list of publications
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