My name is Abdol-Reza Mansouri and I am a Professor of Mathematics here at Queen's.

My research interests are primarily in sub-Riemannian geometry and stochastic analysis, but extend to other areas such as the study of topological obstructions and inverse partial differential equation problems.

Here are some of the problems I would like to attack in the very near future, each forming the core of a suitable Master's or PhD research problem.

Problem 1 A fundamental problem in sub-Riemannian geometry is that of the regularity of length-minimizing curves. It has been shown recently that such curves cannot have corner-type singularities. The aim of this research is to identify additional types of singularities that sub-Riemannian length-minimizing curves cannot exhibit.

Problem 2 It is known that a suitably defined random walk on a sub-Riemannian manifold converges in law to a "horizontal" Brownian motion, directly tied to the sub-Laplacian. The aim of this research is to identify further geometric information that can be recovered from such processes, and, in particular, the structure of the cut and conjugate loci.

Problem 3 The study of stochastic processes on manifolds lies at the interface between stochastic analysis and differential geometry. Limiting distributions of the nodal area of random eigenfunctions on the sphere and torus have been obtained using the Malliavin calculus. The aim of this research is to extend this analysis to more general spaces.

Problem 4 The Malliavin-Stein method is a very powerful tool for establishing probabilistic limit theorems. The aim of this research is to extend Malliavin-Stein to incorporate suitably defined constraints on the target distributions.

If you find any of these problems interesting or would like to learn more about them, do not hesitate to contact me at mansouri@queensu.ca