Capstone Project descriptions

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I suggest the following three directions for Capstone Projects. Any of these could lead a publication. I am also open to discussing any other research opportunities.

Topic 1. **Geometric functional inequalities and applications**

We will deal with a fascinating area of mathematical analysis devoted to functional inequalities associated with operators with different geometries. This is an internationally very active area of research that witnessed a big boost during the last years. In this project, we will aim at deriving new inequalities and at linking them to several problems of geometry and physics, as well as the analysis on (homogeneous) Lie groups.

Topic 2. **Spectral geometry of partial differential equations**

The aim of this research project is to analyze the studies underpinning spectral geometric inequalities arising in the theory of partial differential equations (PDE). We study modern new techniques of the relevant spectral theory, the advanced techniques of geometric rearrangements, and systematically demonstrate the learned techniques in various applications ranging from MEMS (micro-electro mechanical systems) problems to problems of galactic dynamics.

Topic 3. **Partial differential equations with singularities**

In this project, we will deal with different models of partial differential equations with coefficients exhibiting singular behavior. It is well known that the classical theory of distributions does not apply in the case of strong singularities, however, recently new approaches have emerged based on the so-called very weak solutions. We will investigate the properties of such solutions in several fundamental models from points of view of both pure and applied mathematics.