PRINCETON UNIVERSITY
DEPARTMENT OF MATHEMATICS

RTG Conference on Geometric Analysis and Diversity in Mathematics Festival

June 19-22, 2019
Lewis 120 — Princeton University

WEDNESDAY JUNE 19TH

Antoine Song   9:30AM
Complexities of minimal hypersurfaces with bounded area

In this talk, we are interested in minimal hypersurfaces with bounded area but large Morse index. How "complicated" can they be compared to their index? We will give some quantitative answers: for instance, for closed minimal surfaces with bounded area in a closed 3-manifold, genus and index are equivalent.

Pengfei Guan 11:00AM
Isometric embedding problems and regularity of scalar curvature equation

We discuss recent work on the Weyl problem of isometric embeddings of (S^2, g) to general ambient space $(N^3, \bar g)$ with warped product structure. When N^3 is R^3, it is the classical Weyl's problem, which was solved by Nirenberg, Pogorelov in 1950s. Solutions to Weyl's problem play important role in the definition of quasi local masses. This leads to the question of isometric embedding (S^2, g) to ambient spaces with horizons, like anti-de Sitter-Schwarzchild space. We discuss some recent works in this direction: regularity of immersed surfaces in warped product space, openness and non-rigidity results. The regularity problem is related to scalar curvature equation. We will also discuss refined Heinz type interior curvature estimates of this type of equations in general dimensions, which is related to a longstanding problem in fully nonlinear PDE, the interior regularity of σ_2-Hessian equation

Matthew Gursky 2:00PM
Chern-Gauss-Bonnet Formula for Singular Yamabe Metrics in Dimension Four

I will describe recent work with R. Graham in which we derive a formula of Chern-Gauss-Bonnet-type for the Euler characteristic of a four dimensional manifold-with-boundary in terms of the geometry of the singular Yamabe metric in a prescribed conformal class. I will also discuss a variational interpretation of the formula and some interesting generalizations.

Robin Neumayer 3:30PM
The Cheeger constant of a Jordan domain without necks

In 1970, Cheeger established lower bounds on the first eigenvalue of the Laplacian on compact Riemannian manifolds in terms of a certain isoperimetric problem. The analogous problem on domains of Euclidean space has generated much interest in recent years, due in part to its

connections to capillarity theory, image processing, and landslide modeling. In this talk, based on joint work with Leonardi and Saracco, we give an explicit characterization of minimizers in this isoperimetric problem for a very general class of planar domains.

THURSDAY JUNE 20TH

Lucas Ambrozio 9:30AM
Free boundary minimal surfaces in the Euclidean ball

Consider a compact surface with boundary in the Euclidean space, and assume its boundary is contained in a sphere. This surface is called a free boundary minimal surface when it has zero mean curvature and intersects the boundary of the ball orthogonally. The minimal surfaces that satisfy this natural boundary condition have very interesting properties, and many mathematical tools have been brought together in recent years to construct examples of these surfaces and understand them. In this talk, I will survey recent developments on the field, highlighting open questions and pointing out a few contributions obtained in collaboration with Ivaldo Nunes (UFMA), and Alessandro Carlotto (ETH-Zuerich) and Ben Sharp (Leeds).

Celso Vianna   11:00 AM
Volume preserving stable constant mean curvature hypersurfaces in spherical space forms

In this talk we address the problem of classifying constant mean curvature hypersurfaces which are stable for the isoperimetric problem. We will briefly review the problem in some spherical space forms of dimension 3 and discuss a recent result in higher dimensions.

Sagun Chanillo   2:00PM
Wave Equations and Conformal Geometry

We study some wave equations whose elliptic parts are well studied in Conformal Geometry. These include the Gauss curvature equation and the H-surface equation, studied by Alice Chang, Paul Yang and Haim Brèzis and J.-M. Coron respectively. We analyze the blow up behavior and the local well-posedness question in energy critical spaces. For the H surface equation, we introduce randomization of initial data to study local well- posedness. This is joint work in part with Po-lam Yung and also with M. Czubak, D.Mendelson, A. Nahmod and G. Staffiliani.

Xin Zhou 3:30PM
Min-max theory for constant mean curvature (CMC) hypersurfaces and applications

I will first present joint works with Jonathan Zhu on the min-max construction of CMC hypersurfaces in any closed Riemannian manifold. If time permits, I will explain the connection between the CMC min-max theory and my recent proof of the Multiplicity One Conjecture.

FRIDAY JUNE 21ST (Diversity in Mathematics Festival)

Marco Guaraco 9:30AM
Min-max for Allen-Cahn and other topics

During the first part of the talk I will cover joint work with P. Gaspar on the existence of solutions to the Allen-Cahn equation. In the remaining time, I will discuss more recent developments. My intention is that the first part serves both as a continuation of Chodosh's mini-course as well as preparation for the talks of Gaspar and Mantoulidis on Saturday.

Christine Breiner 11:00AM
Harmonic Maps into Metric Spaces

We consider harmonic maps from a compact Riemann surface to a metric space with upper curvature bounds in the sense of Alexandrov. We will discuss local and global existence results as well as some compactness theory.

Lunch Talk: The Imposter Syndrome
12:00pm Fine Hall Common Room

Sean Paul 2:00PM
Fourier-Mukai Transforms, Euler Green Currents, and K-Stability

We provide an analog of the Hilbert-Chow morphism for discriminants. As an application we recover a well-known result of Ding and Tian concerning the asymptotic behavior of the Mabuchi Energy under a special degeneration.

Lu Wang 3:30PM
Topology of the level set flows of cones

In this talk, I will discuss the topological properties of level set flows that come out of a cone. This is joint work with Jacob Bernstein.

SATURDAY JUNE 22ND

Jeffrey Case 9:00AM
Conformally variational invariants

Conformally variational Riemannian invariants (CVIs), such as the scalar curvature, are homogeneous scalar invariants which arise as the gradient of a Riemannian functional. In this talk, I will (a) demonstrate that many stability and rigidity results for scalar curvature extend to CVIs and (b) discuss a general correspondence between CVIs and conformally covariant operators which is especially useful for studying variational problems. This is joint work with Yueh-Ju Lin and Wei Yuan.

Pedro Gaspar 10:30AM
Energy levels and nodal sets of infinitely many solutions of the Allen-Cahn equation

We describe some recent contributions on the analogies between the elliptic Allen-Cahn equation and the theory of minimal hypersurfaces in closed manifolds, emphasizing how they can be used to shed light on questions about existence and some geometric and analytic features of critical points of the corresponding energy functional. We review a variational construction of solutions, from joint work with M. Guaraco, which culminates in a Weyl law for the corresponding energy levels, inspired by the work of Liokumovich-Marques-Neves. In a different direction, we describe a recent joint work with R. Caju on the existence of solutions whose nodal sets accumulate around a given minimal hypersurface in closed manifolds with symmetries, extending a result of F. Pacard and M. Ritoré and allowing us to find solutions in the three-dimensional sphere with nodal sets having any given genus.

Christos Mantoulidis 11:30AM
Minimal surfaces via Allen—Cahn

We will survey the construction of minimal surfaces (critical points of the area functional) as limits of solutions of the Allen--Cahn equation, $eps^2 \Delta u = u^3 - u$, with $eps \to 0$. We will focus on Allen--Cahn solutions that arise from min-max constructions by Gaspar and Guaraco, and we'll discuss properties of the corresponding minimal surfaces. Part of this talk is joint work with Otis Chodosh from Princeton University.