Rutgers Geometric Analysis Conference 2025

Scientific Program

Monday May 19th

9:30am -10:30am
Speaker: Christine Breiner (Brown University)

Title: Harmonic maps into Euclidean buildings
Abstract: We describe a regularity result for equivariant harmonic maps from the universal cover of a Riemannian manifold into a (not necessarily locally finite) Euclidean building. As an application we prove non-Archimedean superrigidity for rank 1 symmetric spaces. This result extends the work of Gromov-Schoen, who proved p-adic superrigidity by considering locally finite targets. This work is joint with B. Dees and C. Mese.

10:45am - 11:45am
Speaker: Riccardo Caniato (Caltech)

Title: Area rigidity for the regular representation of surface groups.
Abstract: Starting from the celebrated results of Eells and Sampson, a rich and flourishing literature has developed around equivariant harmonic maps from the universal cover of Riemann surfaces into nonpositively curved target spaces. In particular, such maps are known to be rigid, in the sense that they are unique up to natural equivalence. Unfortunately, this rigidity property fails when the target space has positive curvature, and comparatively little is known in this framework.

In this talk, given a closed Riemann surface with strictly negative Euler characteristic and a unitary representation of its fundamental group on a separable complex Hilbert space H which is weakly equivalent to the regular representation, we aim to discuss a lower bound on the Dirichlet energy of equivariant harmonic maps from the universal cover of the surface into the unit sphere S of H, and to give a complete classification of the cases in which the equality is achieved. As a remarkable corollary, we obtain a lower bound on the area of equivariant minimal surfaces in S, and we determine all the representations for which there exists an equivariant, area-minimizing minimal surface in S.

The subject matter of this talk is a joint work with Antoine Song (Caltech) and Xingzhe Li (Cornell University).

LUNCH

1:45pm - 2:45pm
Speaker: Dylan Galt (Stony Brook University)

Title: Progress Towards a Generalized Connected Sum Construction for Compact Coassociative 4-Folds
Abstract: Coassociatives are four-dimensional calibrated submanifolds of G_2 manifolds, seven dimensional manifolds with holonomy G_2. There is especially rich geometry to be studied when two coassociatives intersect transversely inside the ambient G_2 manifold. Non-compact examples of this phenomenon involving the Harvey-Lawson $Sp(1)$ invariant coassociatives in R^7 have been studied by Lotay and Kapouleas, who use the $U(1)$ symmetry in these examples to show the transverse intersection can be resolved by gluing in a family of Lawlor necks. The topology of the resulting coassociative is that of a generalized connected sum: the connected sum of the original two coassociatives along their intersection circles. In this talk, I will report on progress towards a generalization of this gluing construction for compact coassociative submanifolds intersecting transversely in an arbitrary G_2 manifold. If time permits, I will also describe an invariant for certain types of such transverse coassociative pairs.

3:15pm - 4:15pm
Speaker: Jacob Bernstein (Johns Hopkins University)

Title: Entropy and conformal volume of submanifolds .
Abstract: We show that the entropy of a submanifold can be bounded from below by its (normalized) conformal volume. A consequence is the partial confirmation of a conjecture of Colding-Minicozzi about the entropy of higher codimension closed submanifolds.

4:30pm - 5:30pm
Speaker: Theodora Bourni (University of Tennessee at Knoxville)

Title: Ancient solutions to free boundary curve shortening flow.
Abstract: We will discuss a classification of all compact and non compact convex ancient free boundary curve shortening flows in any convex domain of the Euclidean plane.

6:15pm **CONFERENCE DINNER**

Tuesday May 20th

9:30am -10:30am
Speaker: Robert Haslhofer (University of Toronto)

Title: Classification of ancient noncollapsed flows in $\mathbb{R}^4$
Abstract: We will discuss our recent classification of noncollapsed singularities of the mean curvature flow in $\mathbb{R}^4$. This is joint work with Kyeongsu Choi.

10:45am - 11:45am
Speaker: Camillo De Lellis (IAS)

Title: The Allard regularity problem
Abstract: Stationary integral varifolds, introduced by Almgren in the sixties, are a very useful generalization of minimal surfaces, which play an important role in a variety of geometric problems. While all known examples of nonsmooth stationary integral varifolds consist of pieces of classical minimal surfaces coming together at a codimension set of singularities, the only general regularity result available is the 1972 celebrated regularity theorem of Allard, which shows that the regular part of the varifold is dense in its support. Even proving that the singular part of 2-dimensional ones in $\mathbb R^3$ has zero 2-dimensional measure is surprisingly challenging. In this talk I will explain what the difficulties are, propose some conjectures which we hope might simplify the problems, and present some partial results towards their solution, which anyway deliver some interesting structural consequences. The talk is based on two joint works with Camillo Brena, Stefano Decio, and Federico Franceschini.

LUNCH

1:45pm - 2:45pm
Speaker: Adrian Chu (Cornell University)

Title: Using min-max theory to imitate mean curvature flow
Abstract: In 1989, B. White conjectured that every Riemannian 3-sphere has at least 5 embedded minimal tori. We confirm this conjecture for 3-spheres of positive Ricci curvature. Our proof is based on a strategy of using min-max theory to imitate mean curvature flow.

3:15pm - 4:15pm
Speaker: Ovidiu Munteanu (University of Connecticut)

Title: Monotonicity formulas for harmonic functions.
Abstract: On a complete non-compact Riemannian manifold, the existence of certain nontrivial harmonic functions provides a useful tool for obtaining key geometric properties through monotonic quantities. One approach to establishing monotonicity is by integrating the Bochner formula, which involves Ricci curvature, over the sub-level sets of a harmonic function. This method has been employed to derive various geometric inequalities, such as Minkowski-type inequalities for hypersurfaces, as well as volume estimates of Bishop-Gromov type. In this talk, we will survey this technique and highlight some recent applications.

4:30pm - 5:30pm
Speaker: Doug Stryker (Princeton University)

Title: Index and intersections of min-max geodesics
Abstract: The length spectrum of a Riemannian surface is a sequence of geometric invariants called p-widths, which are analogous to the eigenvalues of the Laplacian. Recent work of Chodosh and Mantoulidis guarantees that each p-width equals the length of a closed immersed geodesic. I will discuss joint work with Jared Marx-Kuo and Lorenzo Sarnataro investigating the geometric properties of these associated geodesics, including upper bounds on their Morse index and number of self-intersections.