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Resúmenes del Congreso de la Real Sociedad Matemática Española

Oviedo, 4 a 7 de febrero de 2009

Sesión especial 8: Análisis Geométrico y Geometría de subvariedades

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Width and flow of hypersurfaces by curvature functions

María Calle[1]

Given a Riemannian metric on the 2-sphere, sweep the 2-sphere out by a continuous one-parameter family of closed curves starting and ending at point curves. We can consider the curve of maximal energy in the sweepout, and then take the infimum of this energy over the class of sweepouts homotopic to the original one. The number obtained is called the width of the sweepout. The width is nonnegative, and positive if the sweepout represents a nontrivial homotopy class. A similar concept can be defined for closed hypersurfaces in $\mathbb{R}^{n+1}$. Sweepouts of a closed manifold by closed curves have been used to find closed geodesics on a given homotopy class. Colding and Minicozzi constructed a sweepout such that if a curve in the sweepout has energy close to the width, then the curve is closed to a geodesic. They used this result to give a bound on the extinction time for mean curvature flow. We generalize this bound to a broader class of geometric flows. This class of flows was proven by Andrews to behave similarly to mean curvature flow when evolving convex hypersurfaces.

This is joint work with Steve Kleene and Joel Kramer.

Keywords: sweepout, min-max, width, extinction time, mean curvature flow.

Mathematics Subject Classification 2000: 53C20, 53C21, 53C44

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Remarks on constant mean curvature surfaces in homogeneous spaces

Laurent Hauswirth[1]

We present some recent results on the geometry of minimal and constant mean curvature surfaces in three-dimensional manifolds.

Keywords: Minimal surface, constant mean curvature.

Mathematics Subject Classification 2000: 53A10, 53C42, 53C43

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Infinitesimally homogeneous manifolds with G-structure and isometric immersions

Paolo Piccione[1]

Let M be a differentiable manifold of dimension n, G a Lie subgroup of $\mathrm{GL}(n,\mathbb{R})$, P a G-structure on M and ∇ a connection in M. The triple (M,P,∇) is called an affine manifold with G-structure. There are three tensors that are naturally associated with triples (M,P,∇), namely, the curvature R and the torsion T of ∇, and the covariant derivative I of the G-structure. The triple (M,P,∇) is infinitesimally homogeneous when these three tensors are constant in frames of P. Examples of infinitesimally homogeneous structures are Riemannian manifolds of constant sectional curvature ($G = O(n)$), Kahler manifolds of constant holomorphic curvature ($G = U(n)$), Lie groups with left invariant metrics ($G = 1$), sub-Riemannian contact manifolds of constant holomorphic curvature ($G = U(n) \times 1$), all three-dimensional homogeneous Riemannian geometries appearing in Thurston classification, all three dimensional homogeneous Lorentzian geometries, and many others. In this talk I will briefly describe these G-structures, discuss a G-structure preserving immersion theorem in infinitesimally homogeneous manifolds, with a few applications.

Keywords: Infinitesimally homogeneous manifold, G-structure, isometric immersion.

Mathematics Subject Classification 2000: 53A15, 53B05, 53C10

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Stability of minimal and constant mean curvature surfaces

Antonio Ros[1]

Stable minimal and constant mean curvature surfaces play an important role in Geometry. We will present recent progress in the study of these surfaces.

Keywords: Minimal surface, constant mean curvature, stability operator.

Mathematics Subject Classification 2000: 53A10, 53C42, 49Q05

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Complete stable surfaces in the sub-Riemannian Heisenberg space

César Rosales[1]

We gather some advances about the classification of complete stable surfaces with or without a volume constraint in the sub-Riemannian Heisenberg group. Our main results are Heisenberg counterparts to the classical theorems by do Carmo and Peng, Fischer-Colbrie and Schoen, and Silveira, about the characterization of complete non-compact stable surfaces in Euclidean three-space.

Keywords: Heisenberg group, singular set, stable area-stationary surfaces, second variation, area-minimizing surfaces.

Mathematics Subject Classification 2000: 53C17, 49Q20

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Asymptotic values of minimal graphs in the disc

Harold Rosenberg†[1] **Pascal Collin**

In 1965, Nitsche posed the following problems. Is there a Fatou theorem for minimal graphs in the unit disk, i.e., do bounded solutions of the minimal surface equation have radial limits a.e.? What is the largest set on the unit circle such that a solution exists having no radial limit? We answer these two questions. We prove that a solution to the minimal surface equation in the open unit disk has radial limits a.e. (when the function is not bounded, the limits may be plus and minus infinity). We construct an example for which the finite radial limits are of measure zero. We conjecture the maximum measure for which plus infinity is possible is 1/2. We also consider the asymptotic values of minimal graphs over the hyperbolic plane.

Keywords: Fatou theorem, minimal graph, radial limits.

Mathematics Subject Classification 2000: 53A10, 53C42, 53C43

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On constant mean curvature cylinders of finite type in $\mathbb{S}^3$

Martin Schmidt[1]

Alexandrov extended his classification of closed CMC surfaces in the three-dimensional space forms to immersions, which extend to compact three-dimensional manifolds. The boundaries of these manifolds are the immersed surfaces. In order to classify tori of constant mean curvature embedded in $\mathbb{S}^3$ we consider immersions of a three-dimensional manifold N into $\mathbb{S}^3$, whose boundary ∂N has non-negative mean curvature with respect to the inner normal. If in addition N and ∂N are connected and complete with respect to the induced metric, we call the immersion 1-sided Alexandrov embedded. We prove that all 1-sided Alexandrov embedded CMC cylinders of finite type are surfaces of revolution. In particular all embedded CMC tori in $\mathbb{S}^3$ are Delaunay. First we show with a maximum principle at infinity of Rosenberg that the 1-sided Alexandrov embeddedness is preserved under continuous deformations. With the help of a parametrisation of the moduli space we are able to deform all 1-sided Alexandrov embedded CMC cylinders of finite type into flat 1-sided Alexandrov embedded cylinders. Finally we classify the 1-sided Alexandrov embedded flat cylinders and their connected component, containing only Delaunay surfaces.

Keywords: Constant mean curvature, 1-sided Alexandrov embedded, CMC cylinder, finite type.

Mathematics Subject Classification 2000: 53A10, 53C42

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Surfaces of parallel mean curvature

Francisco Urbano[1]

We study surfaces of parallel mean curvature in $\mathbb{S}^2 \times \mathbb{S}^2$ and $\mathbb{H}^2 \times \mathbb{H}^2$. We obtain two holomorphic differentials for these surfaces and show the intimate relationship between them and surfaces of constant mean curvature in $\mathbb{S}^2 \times \mathbb{R}$ and $\mathbb{H}^2 \times \mathbb{R}$.

Keywords: Parallel mean curvature, holomorphic quadratic differential.

Mathematics Subject Classification 2000: 53A10, 53C42

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