Workshop on Submanifold Theory and Geometric Analysis

UFSCar, São Carlos, Brazil, August 05 – 09, 2019

Tuesday- 8h - 8:50h -Auditório do DM

Yunelsy Nápoles Alvares

(IME/USP, Brazil)

PDE and hypersurfaces with prescribed mean curvature

Abstract. Minicourse 1

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Tuesday- 9h - 9:50h -Auditório do DM

Ildefonso Castro-Infantes

(Universidad de Granada, Spain)

May we find a minimal surface passing through fixed points?

Abstract. Minimal surfaces are an important topic in differential geometry which is closely related to complex analysis. Motivated by the classical approximation theorems of Runge and Mergelyan, uniform approximation results by minimal surfaces have been studied producing an important amount of literature. On the other hand, it is also remarkable in complex analysis the classical interpolation theorem of Weierstrass. It asserts that the values of an entire function may be prescribed on a discrete and closed subset of the Euclidean complex plane. We would present in this talk the first results dealing with interpolation in the setting of minimal surfaces. Concretely, given a Riemann surface M and an integer $n \geq 3$. We prove on [1] that one may prescribe the values of a conformal minimal immersion $M \to \mathbb{R}^n$ on a discrete and closed subset of M. Our result also ensures jet-interpolation of given finite order and we may prescribe the flux map of the immersions. Furthermore, the interpolating immersions can be chosen to be complete, proper into $\mathbb{R}^n$ if the prescribed values are proper, and one-to-one if $n \geq 5$ and the prescription of values is one-to-one. This is a joint work with Antonio Alarcón.

References:

[1] A. Alarcón, I. Castro-Infantes. *Interpolation by conformal minimal surfaces and directed holomorphic curves. Analysis & PDE* 12-2 (2019), 561–604. DOI 10.2140/apde.2019.12.561

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Tuesday- 10:30h - 11:20h -Auditório do DM

Boris Vertman

(Carl von Ossietzky Universität Oldenburg, Germany)

Resolvent Trace Asymptotics on Stratified Spaces

Abstract. Let (M, g) be a compact smoothly stratified pseudomanifold with an iterated cone-edge metric satisfying a spectral Witt condition. Under these assumptions the Hodge-Laplacian Δ is essentially self-adjoint. We establish the asymptotic expansion for the resolvent trace of Δ. Our method proceeds by induction on the depth and applies in principle to a larger class of second-order differential operators of regular-singular type, e.g. Dirac Laplacians. Our arguments are functional analytic, do not rely on microlocal techniques and are very explicit. The results of this paper provide a basis for studying index theory and spectral invariants in the setting of smoothly stratified spaces and in particular allow for the definition of zeta-determinants and analytic torsion in this general setup. This is a joint work with Luiz Hartmann (UFSCar) and Matthias Lesch (Universität Bonn).

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Tuesday- 11:30h - 12:00h -Auditório do DM

José N. V. Gomes

(UFAM, Brazil)

A note on gradient Einstein-type manifold

Abstract. In this talk, we will show that a nontrivial, compact, degenerate or nondegenerate, gradient Einstein-type manifold of constant scalar curvature is isometric to the standard sphere with a well defined potential function. Moreover, under some geometric assumptions, the noncompact case will be also treated. In this case, the main result is that a homogeneous, proper, noncompact, nondegenerate, gradient Einstein-type manifold is an Einstein manifold.

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Tuesday- 14h - 14:50h -Auditório do DM

Luis J. Alías

(Universidad de Murcia - Spain)

The principal curvature theorem and its applications to constant mean curvature hypersurfaces in euclidean space

Abstract. The so called Principal Curvature Theorem (PCT) is a purely geometric result on the principal curvatures of complete hypersurfaces in Euclidean space given by Smyth and Xavier (*Invent. Math.* 90:443–450, 1987) in their proof of Efimov's theorem in dimension greater than two. As another application of the PCT, they also proved that the only complete hypersurfaces immersed in $\mathbb{R}^{n+1}$ with constant mean curvature $H \neq 0$ and having non-positive Ricci curvature are the right circular cylinders of the form $\mathbb{R}^{n-1} \times \mathbb{S}^1(r)$, with $r > 0$, extending to the n-dimensional case a previous result for $n = 2$ due to Klotz and Osserman. In this lecture we will introduce new applications of the PCT to the study of complete hypersurfaces with constant mean curvature immersed into the Euclidean space $\mathbb{R}^{n+1}$, and, more generally, with constant higher order mean curvature. For instance, among other results, we will prove that if Mn is a complete hypersurface in $\mathbb{R}^{n+1}$ $(n \geq 3)$ with constant mean curvature $H \neq 0$ and having two distinct principal curvatures, one of them being simple, then $\sup_M Scal \geq 0$ and equality holds if and only if M is a right circular cylinder $\mathbb{R}^{n-1} \times \mathbb{S}^1(r)$, with $r > 0$. Similarly, we will also prove that if M^n is a complete hypersurface in $\mathbb{R}^{n+1}$ with constant k-th mean curvature $H_k \neq 0$ $(2 \leq k < n)$ and two distinct principal curvatures, one of them being simple, and its Gauss-Kronecker curvature K does no change sign, then $K = 0$ and M is a cylinder $\mathbb{R} \times \mathbb{S}^{n-1}(r)$, with $r > 0$. Our results in this talk are part of our joint work with S. Carolina García Martínez (*Geom. Dedicata* 156:31–47, 2012) and with Josué Meléndez (*Geom. Dedicata* 182:117–131, 2016; *Geom. Dedicata* 199:273–280, 2019).

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Workshop on Submanifold Theory and Geometric Analysis

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Tuesday- 15h - 15:30h -Auditório do DM

Véronica López Cánovas

(Universidad de Murcia - Spain)

Trapped submanifolds into a null hypersurface of de Sitter space

Abstract. We study codimension two trapped submanifolds contained into one of the two following null hypersurfaces of de Sitter spacetime: (i) the future component of the light cone, and (ii) the past infinite of the steady state space. For codimension two compact spacelike submanifolds in the light cone we show that they are conformally diffeomorphic to the round sphere. This fact enables us to deduce that the problem of characterizing compact marginally trapped submanifolds into the light cone is equivalent to solving the Yamabe problem on the round sphere, allowing us to obtain our main classification result for such submanifolds. We also fully describe the codimension two compact marginally trapped submanifolds contained into the past infinite of the steady state space and characterize those having parallel mean curvature field. Finally, we consider the more general case of codimension two complete, non-compact, weakly trapped spacelike submanifolds contained into the light cone. This is a joint work with Luis J. Alías and Marco Rigoli.

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Tuesday- 16h - 16:50h -Auditório do DM

Francisco Fontenele

(UFF - Brazil)

Finding umbilics on open convex surfaces

Abstract. By the Poincaré-Hopf theorem every ovaloid has at least one umbilic. In this paper we extend this result to the more general case of complete positively curved surfaces in $\mathbb{R}^3$ whose shape operator A satisfies $\inf |A| > 0$ and $\sup |\nabla A| < \infty$. This is a joint work with Frederico Xavier (University of Notre Dame - USA).

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Tuesday- 17h - 17:50h -Auditório do DM

Francisco C. Caramello Jr.

(IME/USP, Brazil)

Introduction to Orbifolds

Abstract. These are course notes, intended to survey the basics of orbifold theory, for the mini-course "Introduction to Orbifolds" held on the Workshop on Submanifold Theory and Geometric Analysis at Federal University of São Carlos, Brazil (August 05 – 09, 2019). We introduce orbifolds, relating them with group actions, then we see how elementary objects from Algebraic Topology generalize to orbifolds, such as the fundamental group and Euler characteristic, then we proceed to the generalizations of classical objects from Differential Geometry to orbifolds, studding orbibundles, differential forms, integration and De Rham cohomology, and finally we endow orbifolds with Riemannian metrics and survey some generalizations of classical results from Riemannian Geometry to this setting.

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