ICM2018 Satellite Conference
Modern Trends in Differential Geometry

Universidade de São Paulo
July 23-27, 2018

- **Welcome to São Paulo!** Please check the webpage ⟨https://www.ime.usp.br/~mtg/⟩ for further information.

- All talks will be held in *Auditório Professor Francisco Romeu Landi*, Travessa 3, Av. Prof. Luciano Gualberto, 380 – Butantã, São Paulo – SP, 05508-010. It is located in the building of the administration of the Polytechnic School of USP.

- The official hotel is *WZ Jardins*, Av. Rebouças, 955 – Phones: (11) 3069-0000 or 0800-129422 (toll free) – URL: ⟨http://www.wzjardins.com.br⟩. There will be shuttle service from the hotel to campus and back every day.

- There will be a special problem session on Thursday afternoon hosted by Frank Morgan and Pierre Pansu.

- A special issue devoted to the conference will be published by the *São Paulo Journal of Mathematical Sciences*. All registered participants are encouraged to submit a contribution.

- The conference dinner will be on Thursday, July 26, at 7:30pm. The venue's address is *Churrascaria Bovinu's Rebouças*, Av. Rebouças, 1604 – Phones: (11) 3085-4873 and (11) 3064-5330. **Please sign up at registration.** Free transportation from the hotel and back will be provided.

Program

Monday, July 23rd

8am	Vans leave hotel to campus
9-9:20am	REGISTRATION
9:20-9:40am	OPENING SESSION
9:40-10:40am	**J. Pérez:** *Recent advances in minimal surface theory in $\mathbb{R}^3$*
10:40-11am	COFFEE-BREAK
11-Noon	**D. Maximo:** *On Morse index estimates for minimal surfaces*
Noon-2pm	LUNCH AND REGISTRATION
2-3pm	**R. L. Fernandes:** *Bochner-Kähler metrics (after R. Bryant)*
3-3:30pm	COFFE-BREAK
3:30-4:30pm	**J. Lauret:** *Homogeneous Ricci curvature and the beta operator*
5pm	Vans leave campus to hotel

Tuesday, July 24th

8:30am	Vans leave hotel to campus
9:30-10:30am	**P. Pansu:** *Large scale conformal geometry*
10:30-10:50am	COFFEE-BREAK
10:50-11:50am	**D. Hulin:** *Harmonic maps in negative curvature*
Noon-2:30pm	LUNCH AND POSTER EXHIBITION
2:30-3:30pm	**E. Falbel:** *Flag structures on 3-manifolds*
3:30-4pm	COFFE-BREAK
4-5pm	**C. de Lellis:** *Boundary regularity for area minimizing currents and a question of Almgren*
5:30pm	Vans leave campus to hotel

Wednesday, July 25th

8:30am	Vans leave hotel to campus
9:30-10:30am	**B. Wilking:** *Torus actions on positively curved manifolds*
10:30-10:50am	COFFEE-BREAK
10:50-11:50am	**B. Hanke:** *Positive scalar curvature on manifolds with abelian fundamental groups*
Noon-2:30pm	LUNCH AND POSTER EXHIBITION
2:30-3:30pm	**W. Ziller:** *Finsler metrics, closed geodesics and geodesic flows*
3:30-4pm	COFFE-BREAK
4-5pm	**M. Radeschi:** *Manifold submetries and polynomial algebras*
5:30pm	Vans leave campus to hotel

Thursday, July 26th

8:30am	Vans leave hotel to campus
9:30-10:30am	**G. Tian:** *Relative volume comparison along Ricci Flow*
10:30-10:50am	COFFEE-BREAK
10:50-11:50am	**M. Abreu:** *A toric geometry road from Kaehler metrics to contact topology*
Noon-2pm	LUNCH
2-3pm	**T. Rivière:** *A proof of the multiplicity one conjecture for minmax minimal surfaces in arbitrary codimension*
3-3:30pm	COFFEE-BREAK
3:30-5pm	*Problem Session*
5:30pm	Vans leave campus to hotel
7:30pm	CONFERENCE DINNER

Friday, July 27th

9:30am	Vans leave hotel to campus
10:30-11:30am	**C. Olmos:** *Submanifolds, holonomy and homogeneous geometry*
Noon-2pm	LUNCH
2-3pm	**R. Miatello:** *On the Hodge spectra of lens spaces*
3-4pm	**F. Morgan:** *Isoperimetric and partitioning problems*
4-4:30pm	COFFE-BREAK
5pm	Vans leave campus to hotel

END OF ACTIVITIES

LIST OF ABSTRACTS OF TALKS

Miguel Abreu (INSTITUTO SUPERIOR TÉCNICO, LISBON, PORTUGAL): *A toric geometry road from Kaehler metrics to contact topology*

Toric manifolds provide interesting hands-on testing grounds for several areas of mathematics. In this talk I will exemplify this in the context of explicit constructions of constant scalar curvature Kaehler metrics (in part jointly with Rosa Sena-Dias) and of contact structures with zero first Chern class (joint with Leonardo Macarini), and the road that connected them.

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Elisha Falbel (PARIS VII, FRANCE): *Flag structures on 3-manifolds*

Path geometry and CR structures on real 3-manifolds were studied by E. Cartan. There is an interesting local geometry with curvature invariants and an interesting global geometry of those structures which are flat. The model spaces are closed orbits of $SL(3, R)$ and $SU(2, 1)$ in a complex flag manifold. We will review these geometries and discuss a notion of flag structure, which includes both geometries. We define a Chern-Simons invariant for such geometric structures.

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Rui Loja Fernandes (INSTITUTO SUPERIOR TÉCNICO, LISBON, PORTUGAL): *Bochner-Kähler metrics (after R. Bryant)*

In a seminal paper, R. Bryant gave a local description of Bochner-Kähler metrics and a classification of germs of such metrics. In this talk I will sketch a new approach to this classification using the theory of Lie algebroids and Lie groupoids. It provides new insight and allows for more precise results, extending the work of Bryant. Our approach can also be used to solve other geometric classification problems (e.g., symplectic connections with special holonomy). This talk is based on joint work with Ivan Struchiner (Univ. of São Paulo, Brazil).

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Bernhard Hanke (AUGSBURG, GERMANY): *Positive scalar curvature on manifolds with abelian fundamental groups*

We introduce Riemannian metrics of positive scalar curvature on manifolds with Baas-Sullivan singularities. This allows us to define a flexible notion of positive homology and to prove a homological invariance principle for positive scalar curvature metrics.

As an application we show the existence of positive scalar curvature metrics on atoral non-spin manifolds of dimension at least five and with odd order abelian fundamental groups. This solves the Gromov-Lawson-Rosenberg conjecture for a new class of manifolds with finite fundamental groups.

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Dominique Hulin (PARIS-SUD, FRANCE): *Harmonic maps in negative curvature*

It has been known, since the pioneering work by Eells and Sampson in the 60's, that any smooth map between compact Riemannian manifolds with negative curvature is homotopic to a harmonic map. In a joint work with Yves Benoist, we extend this result by proving that any quasi-isometric map $f : X \to Y$ between two pinched Hadamard manifolds is within bounded distance from a unique harmonic map. The special case where both $X = Y$ are the real hyperbolic plane, known as the Schoen conjecture, was recently proved by V. Markovic (2016).

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Jorge Lauret (CÓRDOBA, ARGENTINA): *Homogeneous Ricci curvature and the beta operator*

The fact that the main part of the Ricci curvature of a homogeneous space is actually the moment map for the variety of Lie algebras has motivated, during the last two decades, a great amount of applications of geometric invariant theory in homogeneous geometry by several authors. This includes homogeneous Einstein metrics, Ricci solitons, Ricci flow and Ricci negative metrics, besides some applications in complex, symplectic and G_2 geometry, as the Hermitian, Chern, symplectic and Laplacian curvature flows.

A main tool is the beta operator of a homogeneous space G/K, introduced in [L], which is a symmetric operator of the tangent space determined by instability properties of the Lie bracket of the nilradical of G with remarkable geometric properties. The beta operator satisfies a curvature estimate whose equality condition is equivalent to strong structural properties of G/K (algebraic and topological) and holds precisely at Ricci solitons.

In this talk, we will review the definition and properties of the beta operator, including some recent applications in the study of maxima of the Ricci pinching functional

$$F := \frac{scal^2}{|Ric|^2}.$$

[L] J. LAURET, Einstein solvmanifolds are standard, *Ann. of Math.* **172** (2010), 1859-1877.

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Camillo de Lellis (ZÜRICH, SWITZERLAND): *Boundary regularity for area minimizing currents and a question of Almgren*

Consider an area minimizing integral current T which has a smooth boundary Γ of multiplicity 1 in some smooth Riemannian ambient manifold Σ. If the current has codimension 1 a famous work of Hardt and Simon gives full regularity of T at the boundary. In higher codimension Allard's theory can be used to show regularity at points $p \in \Gamma$ where there is a uniformly convex barrier such that T lies locally on one side of it (cf. Hardt's work). While in some cases this guarantees the presence of some regular boundary point, in general the existence of even one of them is still open. In a recent joint work with Guido De Philippis, Jonas

Hirsch and Annalisa Massaccesi we show that boundary regular points are always dense in Γ. This has some interesting consequences on the structure of the minimizer and in particular it allows us to answer positively to a question raised by Almgren at the end of his big regularity paper.

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Davi Maximo (UPENN, USA): *On Morse index estimates for minimal surfaces*

In this talk we will show new estimates involving the Morse index and the topology of minimal surfaces in Euclidean 3-space. This is joint work with Otis Chodosh.

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Roberto Miatello (CÓRDOBA, ARGENTINA): *On the Hodge spectra of lens spaces*

We study the spectra on p-forms of a lens space L by means of representation theory, giving expressions of the eigenvalue spectrum of L in terms of the norm one spectrum of the associated congruence lattice. As a consequence, we construct many manifolds of dimension $n > 4$ that are p-isospectral for every p but are not strongly isospectral. Actually they are not isospectral on other vector bundles over L. We will give connections with toric geometry. This is joint work with Emilio Lauret and Juan Pablo Rossetti.

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Frank Morgan (WILLIAMS COLLEGE, USA): *Isoperimetric and partitioning problems*

The familiar double soap bubble is the least-area way to enclose and separate two given volumes in Euclidean space. What if you give space a density, such as r^2 or e^{r^2} or e^{-r^2}? What is the least-surface-area n-hedral tile? The talk will include recent results and open questions.

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Carlos Olmos (CÓRDOBA, ARGENTINA): *Submanifolds, holonomy and homogeneous geometry*

This will be, mainly, an expository talk. We will intend to give a panorama about the main results and techniques in Euclidean submanifold geometry, which are related to the normal holonomy. These results, surprinsingly, have applications in Riemannian and homogeneous geometry. In the last part we will comment on some new results, in homogeneous geometry, related to the nullity of the curvature tensor (with Di Scala and Vittone) and to the so-called Onishchik index of a symmetric space (with Berndt, and Rodríguez Carreo). We will also refer to some interesting open problems in the area.

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Pierre Pansu (PARIS-SUD, FRANCE): *Large scale conformal geometry*

Inspired by work by Benjamini and Schramm on sphere packings, we introduce a class of large scale conformal maps between metric spaces. It contains all previously studied classes (quasiisometries, uniform embeddings,...) and shares features with quasiconformal maps. Nevertheless, we provide an obstruction to the existence of such maps, between hyperbolic groups in particular.

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Joaquín Pérez (GRANADA, SPAIN): *Recent advances in minimal surface theory in $\mathbb{R}^3$*

We will cover some of the recent progresses in the classical theory of complete embedded minimal surfaces in Euclidean three-space, with emphasis on existence and classification results, asymptotics, the embedded Calabi-Yau problem and the Hoffman-Meeks conjecture. Since limits of embedded minimal surfaces is a crucial tool in obtaining most of these results, we will give some ideas of the different objects one may encounter when dealing with such limits, focusing on a recent convergence result by Meeks, Perez and Ros built on Colding-Minicozzi theory. If time permits, we will discuss some ideas of the proof of a recent solution of the embedded Calabi-Yau problem for finite genus and countably many limit ends.

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Marco Radeschi (NOTRE DAME, USA): *Manifold submetries and polynomial algebras*

Manifold submetries generalize Riemannian submersions, isometric group actions, and isoparametric maps. The local structure of Riemannian submersions around a point, is determined by Riemannian submersions from round spheres. In this talk, we will prove a surprising equivalence between the class of Riemannian submersions from spheres, and a class of polynomial algebras, with applications, for example, to Invariant Theory. This is based on a joint work with Ricardo Mendes.

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Tristan Rivière (ETH, ZÜRICH, SWITZERLAND): *A proof of the multiplicity one conjecture for minmax minimal surfaces in arbitrary codimension*

Given any admissible k-dimensional family of immersions of a given closed oriented surface into an arbitrary closed Riemannian manifold, we prove that the corresponding min-max width for the area is achieved by a smooth (possibly branched) immersed minimal surface with multiplicity one and Morse index bounded by k.

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Gang Tian (PRINCETON, USA): *Relative volume comparison along Ricci Flow*

Perelmans non-collapsing theorem plays a crucial role in his solution for the Geometrization of 3-manifolds. In this talk, I will present a relative volume comparison result which generalizes this non-collapsing theorem. I will also discuss an application of this volume comparison. This is a joint work with Z. L. Zhang.

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Burkhard Wilking (MÜNSTER, GERMANY): *Torus actions on positively curved manifolds*

We study the topology of fixed point components of 5-tori acting isometrically and effectively on positively curved orientable manifolds. Among other things we show that such a component is rationally equivalent to a rank 1 symmetric space. In even dimensions we get as a corollary that the Hopf conjecture under suitable symmetry assumptions. More precisely, an even dimensional positively curved manifold has positive Euler characteristic, provided the rank of its isometry group is at least 5.

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Wolfgang Ziller (UPENN, USA): *Finsler metrics, closed geodesics and geodesic flows*

We study the closed geodesics of Finsler metrics with constant curvature. This is joint work with R. Bryant, P. Foulon, S. Ivanov and V. Matveev.

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LIST OF POSTERS

Tuesday, July 24th

Luis Eduardo Osorio Acevedo (IME-USP, BRAZIL): *Small volumes implies small diameters, via an intrinsic monotonicity formula in Riemannian manifolds*
Ian Adelstein (YALE, USA): *The G-invariant spectrum and non-orbifold singularities*
Sergio Julio Chion Aguirre (IMPA, BRAZIL): *Euclidean hypersurfaces with genuine conformal deformations in codimension two*
Lashi Bandara (POTSDAM, GERMANY): *Boundary value problems for general first-order elliptic operators*
Maria Laura Barberis (CÓRDOBA, ARGENTINA): *Killing forms on negatively curved manifolds*
Mirjana Djorić (BELGRADE, SERBIA): *Certain submanifolds of complex space forms*
Abraham Munoz Flores (UERJ, BRAZIL): *The isoperimetric problem of a complete Riemannian manifold with a finite number of C^0-asymptotically Schwarzschild ends*
Julio Cesar Correa Hoyos (IME-USP, BRAZIL): *The Riemannian intrinsic Allard regularity theorem for integral varifolds and applications to the Riemannian isoperimetric problem for small and arbitrary volumes*
Álvaro Krüger Ramos (UFRGS, BRAZIL): *CMC surfaces in hyperbolic 3-manifolds of finite volume*
Marcos Salvai (CÓRDOBA, ARGENTINA): *Polar factorization of conformal and projective maps of the sphere in the sense of optimal mass transport*
Márcio F. da Silva (UFABC, BRAZIL): *Solutions for equations involving the infinity-Laplacian*

Wednesday, July 25th

Musavvir Ali (Aligarh, India): *Curvature of Reisnerr-Nordström soliton determined as characteristic value*
Leonardo Soriani Alves (Unicamp, Brazil): *Brane correspondence between T-duals via generalized complex geometry*
Valter Borges (UnB, Brazil): *Ricci almost solitons on semi-Riemannian warped products*
Felipe Franco (ICMC-USP, Brazil): *On spaces of special elliptic n-gons*
Abraão Mendes (UFAm, Brazil): *Generic simplicity of the eigenvalues of the drifting Laplacian on compact Riemannian manifolds"*
Andrés J. Moreno (Unicamp, Brazil): *The Weitzenböck formula for the Füter-Dirac operator*
Adriana V. Nicoli (IME-USP, Brazil): *A topological lower bound for the energy of a unit vector field on closed Euclidean hypersurfaces*
Diego Sousa de Oliveira (UFABC, Brazil): *Eigenstructure of Laplace operator on the equilateral triangle and its relation with hexagonal flat torus*
Hiuru Fellipe Santos dos Reis (IFG, Goiás, Brazil): *The mean curvature flow by parallel hypersurface*
João Paulo dos Santos (UnB, Brazil): *Intrinsic and extrinsic geometry of hypersurfaces in $S^n \times \mathbb{R}$ and $H^n \times \mathbb{R}$*
Guillermo Antonio Lobos Villagra (UFSCar, Brazil): *A characterization of pseudo-parallel surfaces*