

The Second Japanese-Spanish Workshop on Differential Geometry

Tokyo Institute of Technology

5.–10. Feb. 2014

Program (04. Feb. 2014)

5. Feb. (Wed)

09:30–10:00 Registration

10:00–10:15 Opening

10:15–11:05 **Joaquín Pérez** (Universidad de Granada)

Title: **Weak CMC foliations with singularities of $\mathbb{R}^3$**

Abstract: We will classify codimension-one foliations in Euclidean three space with leaves of constant mean curvature (CMC) and countably many singularities: those foliations reduce to the standard examples with leaves contained in spheres and planes, and the number of singularities is 0,1 or 2. A similar result holds when the ambient manifold is the standard three-sphere (number of singularities is now 1 or 2), and when CMC foliations are relaxed by weak CMC foliations, whose CMC leaves are allowed to intersect in the manner than Alexandrov-embedded surfaces do. Crucial in this classification result are a removable singularity theorem for isolated singularities of an H -lamination in any Riemannian three-manifold and a universal scale invariant curvature estimate for CMC foliations of Riemannian three-manifolds with boundary, solely in terms of an upper bound of the ambient sectional curvature and of the distance to the ambient boundary. This is joint work with Bill Meeks and Antonio Ros.

11:15–12:05 **Motoko Kotani** (Tohoku University)

Title: **Mathematical challenge to a new phase of materials science**

Lunch

13:30–14:00 **Toshihiro Shoda** (Saga University)

Title: **Behavior of one-parameter families of minimal surfaces in flat tori in terms of Morse index**

14:10–14:40 **Magdalena Rodríguez** (Universidad de Granada)

Title: **Minimal surfaces in $\mathbb{H}^2 \times \mathbb{R}$ asymptotic to polygonals at infinity**

Abstract: In the classical theory of minimal surfaces in $\mathbb{R}^3$, the better known ones are those with finite total curvature. Hauswirth and Rosenberg started in [HR] the corresponding theory of complete minimal

surfaces with finite total curvature in $\mathbb{H}^2 \times \mathbb{R}$. In [HR, HNST] it is proved that a complete minimal surface with finite total curvature in $\mathbb{H}^2 \times \mathbb{R}$ must be proper. Moreover, it must have finite topology and each one of its ends must be asymptotic to a polygonal with a finite number of edges contained in the infinite boundary of $\mathbb{H}^2 \times \mathbb{R}$. In this talk I show that these conditions are not only necessary but also sufficient. This is a joint work with Laurent Hauswirth and Ana María Menezes.

[HR] L. Hauswirth and H. Rosenberg, *Minimal surfaces of finite total curvature in $\mathbb{H} \times \mathbb{R}$* , Mat. Contemp. **31**: 65-80 (2006).

[HNST] L. Hauswirth, B. Nelli, R. Sa Earp and E. Toubiana, *Minimal ends in $\mathbb{H} \times \mathbb{R}$ with finite total curvature and a Schoen type theorem*, Preprint.

14:50–15:40 **Joan Porti** (Universitat Autònoma de Barcelona)

Title: **Actions at infinity on symmetric spaces**

Abstract: The dynamics of a Kleinian group action on the ideal boundary of hyperbolic space is understood. There is a minimal set and its complement is a domain of discontinuity for the action. For higher rank symmetric spaces of noncompact type $X = G/K$, this decomposition does not exist anymore. In this talk I will give constructions of domains in the ideal boundary so that the action of a discrete subgroup of G is properly discontinuous and/or cocompact on this domain, in terms of the geometry on the interior. I'll mainly discuss $SL(3)/SO(3)$. This is joint work with M. Kapovich and B. Leeb.

15:55–16:45 **Juan Carlos Marrero** (Universidad de la Laguna)

Title: **From basic aspects of Poisson structures to invariant measures in nonholonomic Mechanics**

Abstract: In this talk, I will present some recent results on the relation between the unimodularity of a linear almost Poisson structure and the existence of invariant volume forms for hamiltonian systems (of a kinetic type) with respect to this structure. Interesting applications of these results to nonholonomic mechanical systems of kinetic type will be also presented.

6. Feb. (Thu)

10:00–10:50 **Sumio Yamada** (Gakushuin University)

Title: **On Penrose-type inequalities in General Relativity**

11:05–11:55 **Kentaro Saji** (Kobe University)

Title: **Geometric invariants of non-degenerate singular points on wave fronts**

Lunch

13:30–14:00 **Gil Solanes** (Universitat Autònoma de Barcelona)

Title: **Integral geometry of complex space forms**

14:10–14:40 **David Martín de Diego** (ICMAT, Madrid)

Title: **Symplectic geometry and the inverse problem of the calculus of variations**

Abstract: The Inverse Problem of the Calculus of Variations is to determine whether a given system of second order differential equations may be derived from a variational principle. We rewrite the classical conditions in terms of symplectic geometry. Moreover, we also address the problem of obtaining the solutions to constrained systems from restricted variational systems in terms of isotropic submanifolds.

14:50–15:40 **José Carlos Díaz-Ramos** (Universidad de Santiago de Compostela)

Title: **Real hypersurfaces in complex space forms**

15:55–16:45 **Miyuki Koiso** (Kyushu University)

Title: **Stable capillary hypersurfaces in a wedge and uniqueness of the minimizer**

Abstract: We study a variational problem for immersed hypersurfaces in a wedge bounded by two hyperplanes in $\mathbb{R}^{n+1}$. The total energy of each hypersurface is the n -dimensional surface area and a positive “wetting energy” on the supporting hyperplanes, and we impose the $(n+1)$ -dimensional volume constraint enclosed by the hypersurfaces. Any stationary hypersurface Σ is a hypersurface with constant mean curvature which meets each supporting hyperplane with constant contact angle, and it is said to be stable if the second variation of the energy is nonnegative for all admissible variations. We show that if Σ is stable and is disjoint from the edge of the wedge, and if $\partial \Sigma$ is embedded for $n = 2$, or if $\partial \Sigma$ is convex for $n \geq 3$, then Σ is part of the hypersphere. Our results also show that the space of stable solutions is not continuous with respect to the variation of the boundary condition. Moreover, we mention the uniqueness of the minimizer. This is joint work with Jaigyoung Choe (KIAS, Korea).

17:30– BANQUET

7. Feb. (Fri)

10:00–10:50 **Jesús Álvarez-López** (Universidad de Santiago de Compostela)

Title: **Witten’s perturbation on strata**

Abstract: Witten’s method is used to prove a version of Morse inequalities on strata of compact Thom-Mather stratifications.

11:05–11:55 **Pablo Mira** (Universidad Politécnica de Cartagena)

Title: **Isolated singularities of Monge-Ampere equations and surface theory**

Lunch

13:30–14:00 **Atsufumi Honda** (Miyakonojo National College of Technology)

Title: **Non-convex anisotropic surface energy and CMC surfaces in the Lorentz-Minkowski space**

14:10–15:00 **Miguel Sánchez** (Universidad de Granada)

Title: **Wind Finsler structures: from Zermelo’s navigation to the causality of spacetimes**

Abstract: The notion of *wind Finsler structure* Σ is developed; this a generalization of Finsler metrics

where the indicatrices at the tangent spaces may not contain the zero vector. In the particular case that these indicatrices are ellipsoids, called here *wind Riemannian structures*, they admit a double interpretation which provides: (a) a model for *Zermelo's navigation problem* even when the trajectories of ships are influenced by *strong* winds or streams, and (b) a natural description of the *causal structure* of relativistic spacetimes endowed with a non-vanishing Killing vector field K (*SSTK spacetimes*), in terms of Finslerian elements. These elements can be regarded as conformally invariant Killing initial data on a partial Cauchy hypersurface. The links between both interpretations as well as the possibility to improve the results on one interpretation by using the other viewpoint, are stressed. (Joint work with E. Caponio and M.A. Javaloyes.)

Poster/Tea

15:40–16:30 **Norio Ejiri** (Meijo University)

Title: **The deformation space of a compact orientable minimal surface in a torus**

8. Feb. (Sat)

09:30–10:20 **Antonio Alarcón** (Universidad de Granada)

Title: **A Riemann-Hilbert problem for holomorphic null curves in $\mathbb{C}^3$**

Abstract: I will provide approximate solutions to certain Riemann-Hilbert boundary value problems for holomorphic null curves in the Complex Euclidean space $\mathbb{C}^3$. As application we will show complete bounded embedded null curves in $\mathbb{C}^3$, properly embedded null curves in $SL(2, \mathbb{C})$, and properly immersed Bryant surfaces in $\mathbb{H}^3$ normalized by any given bordered Riemann surface. Joint work with Franc Forstneric.

10:35–11:25 **Reiko Miyaoka** (Tohoku University)

Title: **Stability of minimal Lagrangian submanifolds and L^2 harmonic 1-forms**

This is a joint work with my PhD student S. Ueki. We show that a non-compact complete stable minimal Lagrangian submanifold L in a Kahler manifold with positive Ricci curvature has no non-trivial L^2 harmonic 1-forms. We report several important related results in this field.

Excursion

9. Feb. (Sun)

09:30–10:20 **José M. Espinar** (IMPA)

Title: **Geometric view of conformal PDES**

10:35–11:05 **Kosuke Naokawa** (Tokyo Institute of Technology)

Title: **Geometry of Möbius strips**

11:20–12:10 **Jun-Ichi Inoguchi** (Yamagata University)

Title: **Minimal surfaces in the Heisenberg group via loop groups**

Lunch

13:30–14:20 **Rafe Mazzeo** (Stanford University)

Title: **The Nahm pole boundary condition for the KW equations**

Poster/Tea

15:00–15:30 **Paul A. Nagy** (Universidad de Murcia)

Title: **Orthogonal symplectic structures**

15:40–16:30 **Shin Nayatani** (Nagoya University)

Title: **Rumin-Bochner formula for 1-forms on a CR manifold**

Abstract: Around 1990, Michel Rumin defined a differential complex for a contact manifold, and developed the associated harmonic theory for a strongly pseudoconvex CR manifold with a fixed contact form. Rumin proved a Bochner-type formula for a harmonic one-form on such a manifold. In this talk, I first recall the basic framework of CR geometry and the definition of the Rumin complex. I then discuss the sharpness of Rumin's formula with an explicit example and an application of the formula to the eigenvalue estimate of the subelliptic Laplacian. I'll also discuss a generalization of the formula to the case of two-forms, motivated by my trial to prove the Bourdon rigidity for complex hyperbolic Kleinian groups by differential-geometric method.

10. Feb. (Mon)

09:30–10:20 **Miguel A. Javaloyes** (Universidad de Murcia)

Title: **Zermelo navigation and flag curvature in wind Finsler structures**

Abstract: the Zermelo problem studies the trajectories which minimize the time in the presence of a wind or current, as for example when we consider a sailboat in the sea or a ship in a river. The solution is given by Finsler metrics whose indicatrix is the translation by the wind vector of the indicatrix of the background metric. When the wind is strong, the origin of coordinates can be away from the indicatrix and then it defines two conic Finsler metrics. In particular, if the background metric is a Riemannian metric, with the translation we will obtain a Randers or a Kropina metric. We show that the flag curvature is preserved when the indicatrix is translated with a Killing field, using the dual metric, which is a Hamiltonian function in the cotangent bundle. Moreover, these metrics also have applications to spacetimes endowed with a Killing field (not necessarily timelike). (joint work with Henrique Vitória.)

10:35–11:05 **Yasufumi Nitta** (Tokyo Institute of Technology)

Title: **On K-stability and asymptotic Chow-stability of polarized algebraic manifolds**

11:20–12:10 **Yu Kawakami** (Yamaguchi University)

Title: **Function-theoretic properties for the Gauss maps of various classes of surfaces**

Lunch

13:30–14:20 **Yoshihiro Ohnita** (Osaka City University)Title: **Geometry of the Gauss images of isoparametric hypersurfaces**14:35–15:05 **Miguel Domínguez-Vázquez** (IMPA)Title: **Isoparametric submanifolds of complex projective spaces**

Abstract: An isoparametric foliation is a certain kind of decomposition of a given Riemannian manifold into equidistant submanifolds, where those of the highest dimension (the so-called isoparametric submanifolds) have parallel mean curvature and the distribution defined by their normal bundles is integrable. In this talk I will present the main ideas of the classification of these objects in complex projective spaces.

15:20–16:10 **Josef F. Dorfmeister** (Technische Universität München)Title: **The loop group method, and some of its applications to find new examples in old fields**

Posters

07. Feb. 15:00–15:40

Miguel Ortega (Universidad de Granada)Title: **A Fundamental Theorem for Hypersurfaces in Semi-Riemannian Warped Products**

Abstract: In this poster, we will show a generalization of two closely related results by B. Daniel and by J. Roth. We obtain a *fundamental theorem* for non-degenerate hypersurfaces M in the semi-Riemannian warped product of an interval and a non-flat semi-Riemannian space form, namely $\pm I \times_a \mathbb{M}_k^n(c)$, $c = \pm 1$. The so-called Gauß and Codazzi equations are necessary, but also the covariant derivative of a tangent vector T to M , which cannot deduce from the structure equations. This vector field T is the tangent component of a ∂_t along the immersion. As an application, we obtain that we cannot always think of a Riemannian manifold as a space-like hypersurface in a Robertson-Walker spacetime with non-flat fibers, since knowing ∇T is crucial. This poster is a summary of a joint work with M.A Lawn, from U. of Texas at Austin, <http://arxiv.org/abs/1401.3327>

Irene Ortiz (Universidad de Murcia)Title: **First stability eigenvalue of compact CMC surfaces****Yuta Ogata** (Kobe University)Title: **Constraction of spacelike CMC surfaces in 3-dimensional Lorentzian spaceforms****Naoki Kitazawa** (Tokyo Institute of Technology)Title: **On manifolds admitting fold maps with singular value sets of concentric spheres**

Yutaro Tomisawa (Yamagata University)

Title: **Helicoidal surfaces with constant mean curvature in hyperbolic 3-space**

Masataka Funata (Yamagata University)

Title: **Constant curvature surfaces in 3-dimensional space forms**

09. Feb. 14:20–15:00

Alma L. Albujer (Universidad de Cordoba)

Title: **Constant mean curvature graphs on convex domains in the Lorentz-Minkowski space**

Abstract: In this poster we study constant mean curvature spacelike graphs in the Lorentz-Minkowski space $\mathbb{L}^3$ with non-empty smooth convex boundary. We are interested in studying the influence of the geometry of the boundary on the geometry of the whole surface. We prove that in the case where the boundary is an ellipse on a spacelike plane of $\mathbb{L}^3$, and the graph is constant along the boundary, the graph is necessarily a strictly convex surface. The results presented in this poster are part of a joint work with Magdalena Caballero (University of Córdoba, Spain) and Rafael López (University of Granada, Spain).

Wataru Sakamoto (Kyushu University)

Title: **Balancing Formula for surfaces with constant anisotropic mean curvature**

Abstract: I study stationary immersed surfaces of anisotropic surface energy for volume-preserving variations in $\mathbb{R}^3$. An anisotropic surface energy is the integral of an energy density function over a surface. The energy density depends on the normal vector field along surfaces. Stationary surfaces are called surfaces with constant anisotropic mean curvature (CAMC surfaces), and they are a generalization of surfaces with constant mean curvature. I give a formula, which is called the balancing formula, for CAMC surfaces. Moreover, by applying this formula, I give a uniqueness result for embedded CAMC surfaces bounded by a round circle. All results are generalized to hypersurfaces in the Euclidean space. This is Joint work with Miyuki Koiso (Kyushu University, Japan).

Masashi Yasumoto (Kobe University)

Title: **Semi-discrete maximal surfaces with singularities in Minkowski space**

■ Lecture Halls:

5.–7. Feb.: Ferrite Memorial Hall (The Centennial Hall, Tokyo Institute of Technology)

8–10. Feb.: The Royal Blue Hall, Tokyo Tech Front (Tokyo Institute of Technology)