International Research Network Project "SYMMETRY, TOPOLOGY and MODULI"

The 13th OCAMI-RIRCM Joint Differential Geometry Workshop on Submanifold Geometry and Lie Theory

Date: March 27 (Mon)- 30 (Thu), 2017
Place: Lecture Room E408, Department of Mathematics, Graduate School of Science, Osaka City University

Organizers: Yoshihiro Ohnita (OCU, Director of OCAMI, Japan), Young Jin Suh (KNU, Director of RIRCM, Korea), Hiroshi Tamaru (Hiroshima University, Japan), Takashi Sakai (Tokyo Metropolitan University, Japan), Toru Kajigaya (AIST & OCAMI, Japan), Hyunjin Lee (KNU & RIRCM, Korea)

Sponsors: Osaka City University Advanced Mathematical Institute (OCAMI), Research Institute of Real and Complex Manifolds (RIRCM) & Department of Mathematics, Kyungpook National University (KNU),

Invited speakers: Professor Andreas Arvanitoyeorgos (University of Patras, Greece)
Professor Anna Gori (Department of Mathematics, University of Milano, Italy)
Professor Giuseppe Pipoli (Universite Grenoble Alpes, France)
Professor Young Jin Suh (RIRCM, Kyungpook National University, Korea)
Professor Byung Hak Kim (Kyung Hee University, Korea)
Professor Makiko Sumi Tanaka (Tokyo University of Science, Japan)
Professor Yumiko Kitagawa (Oita National College of Technology, Japan)
Professor Naoyuki Koike (Tokyo University of Science, Japan)
Professor Yasuyuki Nagatomo (Meiji University, Japan)
Professor Hiroshi Tamaru (Hiroshima University, Japan)
Doctor Hyunjin Lee (RIRCM, Kyungpook National University, Korea)
Doctor Imsoon Jeong (Kyungpook National University, Korea)
Doctor Hikaru Yamamoto (Tokyo University of Science, Japan)
Ms. Marina Statha (University of Patras, Greece)
Dr. Changhwa Woo (Woosuk University, Korea)
Mr. Gyujong Kim (Kyungpook National University, Korea)
Dr. Yuichiro Taketomi (Hiroshima University, Japan)
Dr. Isamu Koga (Kyushu University, Japan)
Dr. Takahiro Hashinaga (National Institute of Technology, Kitakyushu College, Japan)
Dr. Toru Kajigaya (AIST & OCAMI, Japan)
Dr. Shinji Ohno (AIST & OCAMI, Japan)
Title and Abstract of Talks: **PDF**

Andreas Arvanitoyeorgos  
**Title:** Homogeneous Einstein manifolds. An Overview and Recent Results  
**Abstract:** A Riemannian manifold $(M, g)$ is called Einstein if $\nabla \Ric(g) = c g$ for some $c \in \mathbb{R}$. For a homogeneous space $G/H$ the problem is to prove existence of a $G$-invariant metric and if possible find all invariant Einstein metrics (up to scale and isometry). I will restrict to the case when $G>0$ ($G/H$ is compact) and give an overview of recent results for two major classes of homogeneous spaces. For those whose isotropy representation $\chi$ decomposes into a direct sum of irreducible and non equivalent subrepresentations, and those for which $\chi$ contains equivalent subrepresentations. In the last case the description of $G$-invariant metrics is more complicated, which makes the problem of proving existence of invariant Einstein metrics more complicated. Typical examples in the first class of homogeneous spaces are the generalized flag manifolds, and in the second class the Stiefel manifolds (real, complex, or quaternionic). I will also discuss results about Einstein metrics on homogeneous spaces examples of which belong to both classes, such as generalized Wallach spaces. The case of finding left-invariant Einstein on compact Lie groups requires a special attention and we refer to M. Statha's talk about this. **PDF**

Anna Gori  
**Title:** The moment map: a powerful tool in understanding submanifolds geometry  
**Abstract:** Whenever a compact Lie group $G$ acts on a symplectic manifold $M$ in a Hamiltonian fashion it is possible to define a moment map from the manifold to the dual of the Lie algebra of $G$. The aim of the talk is to present several results attained during the past few years by dealing extensively on the properties of such an important function. Namely the following three problems will be addressed: (a) existence of Homogeneous Lagrangian submanifolds in compact Kaehler manifolds with $h^{1,1}=1$, (b) minimality of Lagrangian submanifolds in Kaehler Einstein manifolds; (c) isometrical embeddings in complex projective spaces of submanifolds admitting Kaehler Ricci Solitons .

Giuseppe Pipoli  
**Title:** Mean curvature flow of pinched submanifolds in the complex projective space and in the sphere.  
**Abstract:** The study of the mean curvature flow of pinched submanifold starts in 1987 with Huisken's paper about the evolution of hypersurfaces of the sphere. I will describe an extension of this result to pinched submanifolds of complex projective space and, using the commutativity of the mean curvature flow with the Hopf fibration, to new examples in the sphere. As a consequence we will prove a classification result for the submanifolds considered.

Young Jin Suh  
**Title:** Real hypersurfaces with isometric Reeb flow in Hermitian Symmetric Spaces  
**Abstract:** We investigate real hypersurfaces with isometric Reeb flow in Hermitian symmetric spaces. In particular, we give some classifications of real hypersurfaces with isometric Reeb flow in generalized compact complex k-plane Grassmannians and non-compact complex hyperbolic quadric.

Byung Hak Kim  
**Title:** On Conformal transformation related Ricci curvature conditions  
**Abstract:** In this talk, we are to report recent results of the Riemannian manifolds admitting conformal transformations with various Ricci curvature conditions. Moreover we introduce and consider about the open problems related this topic.

Makiko Sumi Tanaka  
**Title:** Maximal antipodal sets of the bottom space of $Sp(n)/U(n)$  
**Abstract:** We classified maximal antipodal subgroups of the quotients of compact classical Lie groups (to appear in J. Lie Theory). $Cl(n)\cong Sp(n)/U(n)$ is the double covering space of the bottom space denoted by $Cl(n)^\vee$. In this talk we classify maximal antipodal sets of $Cl(n)^\vee$. In order to do that, we use a certain totally geodesic embedding of $Cl(n)$ into $Sp(n)$ and the classification of maximal antipodal subgroups of $Sp(n)\setminus \mathbb{H} \{Z\} \cdot 2$. Moreover, we determine great antipodal sets of $Cl(n)^\vee$ which give the 2-number of $Cl(n)^\vee$. This talk is based on my joint work with Hiroyuki Tasaki.
Abstract: We show a duality which arises from distributions of Cartan type, having growth (2, 3, 5), from the viewpoint of geometric control theory. In fact we consider the space of singular (or abnormal) paths on a given five-dimensional space endowed with a Cartan distribution, which form another five-dimensional space with a cone structure. We regard the cone structure as a control system and show that the space of singular paths of the cone structure is naturally identified with the original space. Moreover we observe an asymmetry on this duality in terms of singular paths.

Naoyuki Koike
Title: Collapse of the regularized mean curvature flow for invariant hypersurfaces in a Hilbert space
Abstract: In this talk, we first state known results for the regularized mean curvature flow starting from an invariant hypersurface in a Hilbert space equipped with an isometric and almost free action of a Hilbert Lie group whose orbits are regularized minimal. Next we prove that, if the initial invariant hypersurface satisfies a certain kind of horizontally convexity condition, then it collapses to an orbit of the Hilbert Lie group action along the regularized mean curvature flow. As its application, we state results for the mean curvature flow in the orbit space of the Hilbert Lie group action, which is a Riemannian orbifold.

Yasuyuki Nagatomo
Title: Harmonic maps from the complex projective line into complex quadrics
Abstract: PDF

Hiroshi Tamaru
Title: TBA
Abstract: TBA

Yuichiro Taketomi
Title: TBA
Abstract: TBA

Hyunjin Lee(*) and Young Jin Suh
Title: The cyclic parallel hypersurfaces in complex Grassmannians with rank 2
Abstract: In this talk, we introduce a notion of cyclic parallelism for real hypersurfaces in complex Grassmannians of rank two and give some results related to this notion.

Young Jin Suh and Changhwa Woo(*)
Title: The maximal existence condition of real hypersurfaces in complex Grassmannians of rank two
Abstract: In this talk, we introduce a notion of parallel Ricci tensor for Hopf hypersurfaces in complex Grassmannians of rank two. We use partially ordered class from the the space spaned by the Reeb vector field to the tangent bunddle of real hypersurfac and try to find the maximal subbundle including Reeb direction which guarantees the existence of real hypersurfaces in the given ambient spaces.

Imsoon Jeong, Gyu Jong Kim(*), and Young Jin Suh
Title: Real hypersurfaces In the Complex quadric with normal Jacobi operator of Codazzi type
Abstract: We introduce the notion of normal Jacobi operator of Codazzi type for real hypersurfaces in the complex quadric $\mathbb{Q}^m = \text{SO}_{m+2}/\text{SO}_m \text{SO}_2$. The normal Jacobi operator of Codazzi type implies that the unit normal vector field $\mathfrak{N}$ becomes $\mathfrak{A}$-principal or $\mathfrak{A}$-isotropic. Then according to each case, we give a complete classification of real hypersurfaces in $\mathbb{Q}^m = \text{SO}_{m+2}/\text{SO}_m \text{SO}_2$ with normal Jacobi operator of Codazzi type.

Hikaru Yamamoto
Title: Ricci-mean curvature flows and its Gauss maps
Abstract: First, I introduce a Ricci-mean curvature flow. A Ricci-mean curvature flow is a coupled equation of a mean curvature flow and a Ricci flow. The ambient metric is evolving under the Ricci flow and a submanifold is moving in this ambient space along the mean curvature flow. Recently, Ricci-mean curvature flows have been appeared in some contexts. In this talk, I will give a generalization of a theorem due to E. Ruh and J. Vilms. They proved that the Gauss map of a minimal submanifold in a Euclidean space is a harmonic map. Then, our
generalization is a time dependent version of that theorem. It says that the Gauss maps of a Ricci-mean curvature flow is a vertically harmonic map heat flow. This is also a generalization of a result due to M.-T. Wang for a mean curvature flow in a Euclidean space. I will also give some applications of this theorem and its variant. This talk is based on a joint work with N. Koike.

Marina Statha  
Title: Non-naturally reductive Einstein metrics on compact simple Lie groups  
Abstract: PDF

Isamu Koga  
Title: Equivariant holomorphic embeddings from the complex projective lines into a complex Grassmannian 2-planes  
Abstract: PDF

Takahiro Hashinaga  
Title: On homogeneous Lagrangian submanifolds in complex hyperbolic spaces  
Abstract: In this talk, we study homogeneous Lagrangian submanifolds in complex hyperbolic spaces. We show there exists a correspondence between compact homogeneous Lagrangian submanifolds in complex hyperbolic spaces and ones in complex Euclidean spaces (or equivalently, complex projective spaces). We also introduce classification results of non-compact homogeneous Lagrangian submanifolds in complex hyperbolic spaces obtained by actions of connected closed subgroups of the solvable part of the Iwasawa decomposition. This talk is based on a joint work with Toru Kajigaya.

Toru Kajigaya  
Title: Reductions of minimal Lagrangian submanifolds with symmetries  
Abstract: We give a Hsiang-Lawson type theorem for minimal Lagrangian submanifolds in a Kahler manifold. More precisely, we show the minimality of a K-invariant Lagrangian submanifold L in a Fano manifold M w.r.t. a globally conformal Kahler metric is equivalent to the minimality of the reduced Lagrangian submanifold L_0=L/K in a Kahler quotient w.r.t. the Hsiang-Lawson metric. Moreover, we give some examples of Kahler reductions by using a circle action obtained from a cohomogeneity one action on a Kahler-Einstein manifold of positive Ricci curvature. These examples are closely related to homogeneous hypersurfaces with isometric Reeb flows. Applying these results, we give several examples of minimal Lagrangian submanifolds via reductions.

Shinji Ohno  
Title: Biharmonic orbits of isotropy representations of symmetric spaces  
Abstract: In this talk, we construct biharmonic submanifolds in hyperspheres as orbits of linear isotropy representations of Riemannian symmetric spaces. In particular, we obtain examples of biharmonic submanifolds in hyperspheres whose co-dimension is greater than one.

Yoshihiro Ohnita  
Title: TBA  
Abstract: TBA

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**Program (provisional)**: PDF

3/27 (Mon)  
PM 13:00-13:30 Lecture Room F405 Shinji Ohno  
PM 13:35-14:05 Lecture Room F405 Isamu Koga  
PM 14:10-14:40 Lecture Room F405 Marina Statha  
PM 15:10-15:40 Lecture Room F405 Yuichiro Taketomi  
PM 15:45-16:15 Lecture Room F405 Hyunjin Lee  
PM 16:20-16:50 Lecture Room F405 Changhwa Woo  
PM 16:55-17:25 Lecture Room F405 Gyu Jong Kim

3/28 (Tue)  
AM 9:30-10:30 Lecture Room E408 Makiko Sumi Tanaka  
AM 10:40-11:40 Lecture Room E408 Anna Gori
**PM 13:30-14:30** Lecture Room E408 Giuseppe Pipoli
**PM 14:40-15:40** Lecture Room E408 Hikaru Yamamoto
**PM 15:50-16:50** Lecture Room E408 Naoyuki Koike

Party

3/29 (Wed) **AM 9:30-10:30** Lecture Room E408 Young Jin Suh
**AM 10:40-11:40** Lecture Room E408 Andreas Arvanitoyeorgos
**PM 13:20-14:20** Lecture Room E408 Toru Kajigaya
**PM 14:30-15:20** Lecture Room E408 Yumiko Kitagawa
**PM 15:30-16:20** Lecture Room E408 Byung Hak Kim
**PM 16:30-17:30** Lecture Room E408 Yasuyuki Nagatomo

3/30 (Thu) **AM 9:30-10:30** Lecture Room E408 Yoshihiro Ohnita
**AM 10:40-11:40** Lecture Room E408 Takahiro Hashinaga

**Suggestion to Speakers:** At the lecture room there are enough blackboards, the computer projector and the visualizer. Please prepare your talk using them.

**Link:** [ICM 2014 Satellite Conference on Real and Complex Submanifolds](#)
Osaka City University Advanced Mathematical Institute (OCAMI)
Department of Mathematics, Osaka City University
The 1st OCAMI-KNUGRG Joint International Workshop on Differential Geometry and Related Fields (Oct. 30- Nov. 3, 2008)
The 2nd OCAMI-KNUGRG Joint International Workshop on Differential Geometry and Related Fields (Oct. 29- Nov. 1, 2009)
The 3rd KNUGRG-OCAMI Joint Differential Geometry Workshop (Nov. 4- Nov. 6, 2010)
The 4th KNUGRG-OCAMI Joint Differential Geometry Workshop (Nov. 2- Nov. 5, 2011)
The 5th KNUGRG-OCAMI Joint Differential Geometry Workshop (Oct. 31- Nov. 2, 2012)
The 7th KNUGRG-OCAMI Joint Differential Geometry Workshop (Sep. 30- Oct. 2, 2013)
The 8th OCAMI-KNUGRG Joint Differential Geometry Workshop (Apr. 14- Apr. 16, 2014)
Poster
Kansai Kenshu Center

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"Mathematical Science of Symmetry, Topology and Moduli, Evolution of International Research Network based on OCAMI"
(Osaka City University - Kobe University - Waseda University, Principal investigator: Yoshihiro Ohnita)
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JSPS Grants-in-Aid for Scientific Research (A) (Principal investigator: Akio Kawauchi, OCAMI)

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