INTERNATIONAL CONFERENCE

NEVANLINNA THEORY AND COMPLEX GEOMETRY IN HONOR OF LÊ VĂN THIÊM′s CENTENARY

26/02/2018 - 02/03/2018

HANOI, VIETNAM

INTERNATIONAL CONFERENCE
NEVANLINNA THEORY AND COMPLEX GEOMETRY IN HONOR OF LÊ VĂN THIÊM's CENTENARY
(Hanoi, 26/02/2018 - 02/03/2018, Vietnam)

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- Hanoi National University of Education, Vietnam

PROGRAM

26th Monday, February 2018
Venue: Institute of Mathematics
Building A6, Institute of Mathematics, 18 Hoang Quoc Viet,
Cau Giay, Hanoi

Morning

08:00 - 09:00	**Registration** 2nd floor, **Building A6**
09:00 - 09:45	**Opening Ceremony** Grand Hall, 2nd floor, **Building A6**
09:45 - 10:15	**Ha Huy Khoai** (Thang Long University) *Le Van Thiem-the founder of contemporary mathematics in Vietnam*
10:15 - 10:45	**Coffee break**
10:45 - 11:35	**Emmanuel Ullmo** (Institut des Hautes Études Scientifiques, France) *Algebraic and holomorphic flows on Abelian varieties and* *Hermitian locally symmetric spaces*
11:35 - 14:00	**Lunch break at Institute of Mathematics**

Afternoon

14:00 - 14:50	**Ngaiming Mok** (University of Hong Kong, Hong Kong) *Geometric structures and substructures on uniruled projective manifolds* *and their interplay with Kähler geometry*
14:50 - 15:05	**Coffee break**
15:05 - 15:55	**George Marinescu** (Universität zu Köln, Germany) *Bergman kernels associated to a sequence of positive line bundles*
15:55 - 16:10	**Coffee break**
16:10 - 17:00	**Xiaonan Ma** (Université Paris-Diderot Paris 7, France) *Quantum Hall effet and Quillen metric*

27th February 2018, Tuesday
Venue: Vietnam Institute for Advanced Study in Mathematics
      7th floor of Ta Quang Buu Library building in HUST's campus
      No 1, Dai Co Viet, Hanoi

Morning

09:00 - 09:50   **Jun-Muk Hwang** (KIAS, The Republic of Korea)
                 Rigidity of Legendrian singularities

9:50 - 10:05   **Coffee break**

10:05 - 10:55   **Elizabeth Wulcan** (Chalmers University of Technology, Sweden)
                 Chern forms of metrics with analytic singularities

10:55 - 11:10   **Coffee break**

11:10 - 12:00   **De-Qi Zhang** (National University of Singapore, Singapore)
                 Polarized endomorphisms of normal projective threefolds
                 in arbitrary characteristic

12:00 - 14:00   **Lunch**

Afternoon

14:00 - 14:50   **Nessim Sibony** (University of Paris-Sud, France)
                 Value distribution theory for parabolic Riemann surfaces

14:50 - 15:05   **Coffee break**

15:05 - 15:55   **Min Ru** (University of Houston, USA)
                 Holomorphic curves into projective varieties intersecting general divisors

15:55 - 16:10   **Coffee break**

16:10 - 17:00   **Weixiao Shen** (Fudan University, People's Republic of China)
                 Transversality for critical relations of families of rational maps

28th February 2018, Wednesday
Venue: Vietnam Institute for Advanced Study in Mathematics
      7th floor of Ta Quang Buu Library building in HUST's campus
      No 1, Dai Co Viet, Hanoi

Morning

09:00 - 09:50   **Nguyen Viet Anh** (Université de Lille 1, France)
      Integrability of holonomy cocycle for singular holomorphic
      foliations by curves

9:50 - 10:05   **Coffee break**

10:05 - 10:55   **Sławomir Kołodziej** (Jagiellonian University, Poland)
      Hölder continuous solutions of Monge-Ampère equations
      on compact Hermitian manifolds

10:55 - 11:10   **Coffee break**

11:10 - 12:00   **Nguyen Quang Dieu** (Hanoi National University of Education)
      Monge-Ampère equations with unbounded boundary values

12:00 - 14:00   **Lunch**

Afternoon

14:00 - 14:50   **Kang-Tae Kim** (Pohang University of Science and Technology)
      On the semicontinuity of the automorphism group
      of pseudoconvex domains

14:50 - 15:10   **Coffee break**

15:10 - 16:00   **John-Erik Fornæss** (Norwegian University of Science and Technology)
      Dynamics of transcendental Henon maps

18:00 -21:00   **Banquet**

01st March 2018, Thursday
Venue: Vietnam Institute for Advanced Study in Mathematics
       7th floor of Ta Quang Buu Library building in HUST's campus
       No 1, Dai Co Viet, Hanoi

Morning

  09:00 - 09:50   **Charles L. Epstein** (University of Pennsylvania, USA)
                 Degenerate elliptic operators in population geneticss

  9:50 - 10:05   **Coffee break**

  10:05 - 10:55   **Tuen Wai Ng** (University of Hong Kong, Hong Kong)
                 Fermat functional equations

  10:55 - 11:10   **Coffee break**

  11:10 - 12:00   **Do Duc Thai** (Hanoi National University of Education)
                 Singular directions of Brody curves

  12:00 - 14:00   **Lunch**

Afternoon

  14:00 - 14:50   **Chin-Yu Hsiao**
                 (Academia Sinica and National Center for Theoretical Sciences)
                 Szego kernels and equivariant embedding theorems
                 for complex and CR manifolds

  14:50 - 15:10   **Coffee break**

  15:10 - 16:00   **Vu Ha Van**
                 (Yale University, USA and National University of Singapore, Singapore)
                 Roots of random functions

02nd March 2018, Friday
Venue: Vietnam Institute for Advanced Study in Mathematics
7th floor of Ta Quang Buu Library building in HUST's campus
No 1, Dai Co Viet, Hanoi

Morning

09:00 - 09:50   **Damian Brotbek** (Université de Strasbourg, France)
Hyperbolicity properties for general complete intersections

9:50 - 10:05   **Coffee break**

10:05 - 10:55   **Thomas Peternell** (Universität Bayreuth, Germany)
Descent of numerically flat vector bundles
the Simpson correspondence and singular ball quotients

10:55 - 11:10   **Coffee break**

11:10 - 12:00   **Chung-Chun Yang** (Nanjing University, People's Republic of China)
Applications of Nevanlinna's theory to functional equations

12:00 - 14:00   **Lunch**

ABSTRACTS

Integrability of holonomy cocycle for singular holomorphic foliations by curves

Viêt-Anh NGUYÊN

Lille University, France

We study the holonomy cocycle $\mathcal{H}$ of a holomorphic foliation $\mathcal{F}$ by Riemann surfaces defined on a compact complex projective surface X satisfying the following two conditions:

- its singularities E are all hyperbolic;
- there is no holomorphic non-constant map $\mathbb{C} \to X$ such that out of E the image of $\mathbb{C}$ is locally contained in a leaf.

Let T be a harmonic current tangent to $\mathcal{F}$ which does not give mass to any invariant analytic curve. Using the leafwise Poincaré metric, we show that $\mathcal{H}$ is integrable with respect to T. Consequently, we infer the existence of the Lyapunov exponent function of T. As an immediate application, every generic singular holomorphic foliation of $\mathbb{CP}^2$ possesses a unique canonical and intrinsic Lyapunov exponent.

Hyperbolicity properties for general complete intersections

Damian Brotbek

Université de Strasbourg, France

In this talk we present a strategy for studying different hyperbolicity properties for complete intersection varieties by reducing the problem to the study of particular families of zero dimensional subschemes in a projective space.

This strategy can be used to prove that a sufficiently ample general complete intersection whose codimension exceeds its dimension (and some other hypotheses) has ample cotangent bundle. This was a conjecture of Debarre established independently by Xie and in a joint work with Darondeau.

It can also be used to prove that a general sufficiently ample hypersurfaces in a projective variety is hyperbolic, which was a conjecture of Kobayashi first proven by Siu by a different approach.

We will also discuss logarithmic analogues of these results which can also be used to derive some statements in Nevanlinna theory, this last part is a joint work with Deng .

Monge-Ampère equations with unbounded boundary values

Nguyen Quang Dieu

Hanoi National University of Education, Vietnam

Let D be a bounded strictly pseudoconvex domain in $\mathbb{C}^n$. Let $\varphi : \partial D \to [-\infty, \infty]$ be an upper-semicontinuous function. We are concerned with the existence and uniqueness of a continuous function u on $\overline{D}$ which is plurisubharmonic on D and satisfies

$$(dd^c u)^n = 0, \lim_{z \to \xi} u(z) = \varphi(\xi), \ \forall \xi \in \partial D.$$

In the case where φ is *bounded*, such a solution function u can be given in terms of the Perron-Bremermann envelope of φ. The aim of this talk is to treat the case where $\varphi = -\log |f|$, where f is a holomorphic function defined on a neighborhood of $\overline{D}$ and vanishes somewhere on D. Our main result states that under some strong geometric conditions on the hypersurface $A := \{f = 0\}$ we will have indeed a unique solution to the above equation. Moreover, the solution is given in terms of the pluricomplex Green function with poles along A.

Degenerate Elliptic Operators in Population Genetics

Charles Epstein

University of Pennsylvania, USA

Models that describe the behavior of evolving populations and financial markets are usually phrased in the language of stochastic differential equations, which in turn define Markov processes. The underlying variables in these processes are confined to subsets that typically have non-smooth boundaries, like simplices and orthants. The PDEs that generate these processes are degenerate elliptic operators, where the degeneracies reflect important empirical properties of the underlying processes. In this talk I will describe a class of such operators, called Kimura diffusions that are naturally defined on manifolds with corners. I will then detail recent progress on the regularity theory and numerical approximation of solutions to the elliptic and parabolic problems, and the tools used to establish these results. This is recent joint work with Rafe Mazzeo, Camelia Pop and Jon Wilkening.

This is not really on complex analysis. If you'd like me to speak on something connected to complex analysis, then I can talk about older work.

Dynamics of transcendental Henon maps

John Erik Fornæss

Norwegian University of Science and Technology, Norway

This is on my joint work with Leandro Arosio, Anna Benini and Han Peters. We study transcendental Henon maps. This is a hybrid of the dynamics of transcendental functions in one complex variable and the dynamics of Polynomial Henon maps on $\mathbb{C}^2$.

Szego kernels and equivariant embedding theorems for complex and CR manifolds

Chin-Yu Hsiao

Academia Sinica and National Center for Theoretical Sciences, Taiwan

We consider a compact connected CR manifold with a transversal CR locally free R-action endowed with a rigid positive CR line bundle. We prove that a certain weighted Fourier-Szego kernel of the CR sections in the high tensor powers admits a full asymptotic expansion and we establish R-equivariant Kodaira embedding theorem for CR manifolds. Using similar methods we also establish an analytic proof of an R-equivariant Boutet de Monvel embedding theorem for strongly pseudoconvex CR manifolds. In particular, we obtain equivariant embedding theorems for irregular Sasakian manifolds. As applications of our results, we obtain Torus equivariant Kodaira and Boutet de Monvel embedding theorems for CR manifolds and Torus equivariant Kodaira embedding theorem for complex manifold.

This is a joint work with Hendrik Herrmann and Xiaoshan Li.

Rigidity of Legendrian singularities

Jun-Muk Hwang

Korea Institute for Advanced Study, The Republic of Korea

Let (M, D) be a holomorphic contact manifold, i.e., a complex manifold M of dimension $2n + 1$ equipped with a holomorphic contact structure D. An $n-$ dimensional complex analytic subvariety V in M is called a Legendrian subvariety if the smooth locus of V is tangent to D. A Legendrian singularity means the germ of a Legendrian subvariety at a point.

We discuss some rigidity results on Legendrian singularities.

On the semicontinuity of the automorphism group of pseudoconvex domains

Kang-Tae Kim

Pohang University of Science and Technology, The Republic of Korea

The semicontinuity phenomenon for the automorphism group action has a deep root in geometry. It was R. E. Greene and S. G. Krantz who introduced this direction of study to the Multidimensional Complex Analysis, around 1980. Then in 2014, Greene and the author discovered a method that can prove the semicontinuity phenomenon on a rather broad collection of domains. In this talk, I shall present further developments beyond [Greene-Kim 2014] in this direction of research.

Bergman kernels associated to a sequence of positive line bundles

George Marinescu

Universität zu Köln, Germany

The asymptotics of Bergman kernels associated to the sequence of tensor powers of a positive line bundle have received a lot of attention in the last years. In this talk we consider more generally a sequence of positive line bundles whose curvatures satisfy a mild growth condition and study the diagonal and off-diagonal asymptotics of their Bergman kernels.

The results are obtained jointly with Dan Coman and Xiaonan Ma.

Quantum Hall effet and Quillen metric

Xiaonan Ma

Université Paris-Diderot Paris 7, France

Let L be a line on a smooth Riemann surface. In the study of the Quantum Hall Effect on a Riemann surface we consider the wave functions given by the holomorphic sections of the $p-$tensor powers of a positive line bundle. The partition function is the square of the L^2-norm of the Slater determinant built with the help of a basis of such sections. We will explain some mathematic problems related to QHE.

Geometric structures and substructures on uniruled projective manifolds and their interplay with Kähler geometry

Ngaiming Mok

The University of Hong Kong

In a series of articles with Jun-Muk Hwang starting from the late 1990s, we introduced a geometric theory of uniruled projective manifolds based on the variety of minimal rational tangents (VMRT), i.e., the collection of tangents to minimal rational curves on a uniruled projective manifold $(X, \mathcal{K})$ equipped with a minimal rational component. This theory provides differential-geometric tools for the study of uniruled projective manifolds, especially Fano manifolds of Picard number 1. Associated to $(X, \mathcal{K})$ is the fibered space $\pi : \mathcal{C}(X) \to X$ of VMRTs, which we will call the VMRT structure on $(X, \mathcal{K})$. More recently, with Jaehyun Hong and Yunxin Zhang we have started the study of germs of complex submanifolds S on uniruled projective manifolds inheriting geometric substructures obtained from intersections of VMRTs with tangent subspaces, giving rise to sub-VMRT structures $\varpi : \mathcal{C}(S) \to S$, $\mathcal{C}(S) := \mathcal{C}(X) \cap \mathbb{P}T(S)$. Central to the study of VMRT and sub-VMRT structures are various types of Recognition Problems, i.e., problems of characterizing special types of Fano manifolds of Picard number 1 or special uniruled projective subvarieties on them in terms of VMRT and sub-VMRTs. In the solutions of certain Recognition Problems one exploits the notion of parallel transport (holonomy) of VMRTs

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along minimal rational curves, a technique that was inspired by Berger's theorem characterizing Riemannian locally symmetric spaces by holonomy groups. (Berger's theorem was made use of in the author's solution of the Generalized Frankel Conjecture in Kähler geometry, which culminated in proving the holonomy invariance of VMRTs.) We will furthermore relate the geometric study of VMRTs and sub-VMRTs to the study of holomorphic isometries between bounded symmetric domains. Especially, we will show how examples of nonstandard holomorphic isometric embeddings of the complex unit ball into irreducible bounded symmetric domains of rank ≥ 2 can be constructed using VMRTs and illustrate how uniqueness results are proven in joint works with Xiaoyu Yang for such maps in certain cases, in which parallel transport (holonomy) again plays an essential role.

Holomorphic curves into projective varieties intersecting general divisors

Min Ru

University of Houston, USA

We establish a general Second Main Theorem type result for holomorphic curves into the projective variety X intersecting general divisor D, in terms of the (birational) Nevanlinna constant $Nev_{bir}(D)$. By computing $Nev_{bir}(D)$ using the filtrations, it recovers (almost all) previous known results in this direction, as well as derive some new results for divisors which are not necessarily linear equivalent on X. The notion $Nev_{bir}(D)$ is originally defined in terms of Weil functions for use in applications, and it is proved later that it can be defined in terms of local effectivity of Cartier divisors after taking a proper birational lifting. This is a joint work with Paul Vojta.

Value Distribution Theory for Parabolic Riemann Surfaces

Nessim Sibony

University of Paris-Sud, France

I will discuss some joint work with Mihai Păun around a conjecture by Green-Griffiths which states that if X is a projective manifold of general type, then there exists an algebraic proper subvariety of X which contains the image of all

holomorphic curves from the complex plane to X. The general case is far from being settled. We question the choice of the complex plane as a source space.

Let $\mathcal{Y}$ be a parabolic Riemann surface, i.e bounded subharmonic functions defined on $\mathcal{Y}$ are constant. The results of Nevanlinna's theory for holomorphic maps f from $\mathcal{Y}$ to the projective line are parallel to the classical case when $\mathcal{Y}$ is the complex line except for a term involving a weighted Euler characteristic. Parabolic Riemann surfaces could be hyperbolic in the Kobayashi sense, i.e admit a Poincaré metric.

Let X be a manifold of general type, and let A be an ample line bundle on X. It is known that there exists a holomorphic jet differential P (of order k) with values in the dual of A. If the map f has infinite area and if $\mathcal{Y}$ has finite Euler characteristic, then f satisfies the differential relation induced by P. As a consequence, we obtain a generalization of Bloch Theorem concerning the Zariski closure of maps f with values in a complex torus. An interesting corollary of these techniques is a refined Ax-Lindemann theorem to transcendental affine varieties (the classical case concerns affine algebraic varieties) for which we give a proof. We then study the degree of Nevanlinna's currents $T[f]$ associated to a parabolic leaf of a foliation $\mathcal{F}$ by Riemann surfaces on a compact complex manifold. We show that the degree of $T[f]$ on the tangent bundle of the foliation is bounded from below in terms of the counting function of f with respect to the singularities of $\mathcal{F}$, and the Euler characteristic of $\mathcal{Y}$. In the case of complex surfaces of general type, we obtain a complete analogue of McQuillan's result: a parabolic curve of infinite area and finite Euler characteristic tangent to $\mathcal{F}$ is not Zariski dense.That requires some analysis of the dynamics of foliations by Riemann Surfaces.

Transversality for critical relations of families of rational maps

Weixiao Shen

Fudan University, People's Republic of China

This is a joint work with Genadi Levin and Sebastian van Strien. We will give a short and elementary proof that critical relations unfold transversally in that space of rational maps of the Riemann sphere.

Descent of numerically flat vector bundles, the Simpson correspondence and singular ball quotients

Thomas Peternell

Mathematisches Institut, Universität Bayreuth, Germany

Im my talk I will explain recent results with Greb, Kebekus and Taji concerning the Simpson correspondence on klt spaces and the uniformization of klt spaces whose (orbifold) Chern classes are extremal in the sense that they satisfy the Miyaoka-Yau equality.

The key is a descent theorem for flat bundles on klt spaces.

Hölder continuous solutions of Monge-Ampèere equations on compact Hermitian manifolds

Slawomir Kolodziej

Jagiellonian University, Poland

T his is joint work with C. N. Nguyen. Let $(X; \omega)$ be a compact Hermitian manifold of complex dimension n. We consider the complex Monge-Ampére equation:

$$(\omega + dd^c\varphi)^n = cd\mu$$

We show that a positive Borel measure $d\mu$ of finite total mass, admits a Hölder continuous solution (for some positive constant c) if and only if it is dominated locally by Monge-Ampèere measures of Hölder continuous plurisubharmonic functions.

Singular directions of brondy curves

Do Duc Thai

Hanoi National University of Education, Vietnam

In our talk, we would like to say about the existence of singular directions of Brody curves into algebraic varieties. Moreover, we also give a version of "angular domain" type for the results of B. F. P. Da Costa and J. Duval, Sur les courbes de Brody dans $P^n(\mathbb{C})$, Math. Ann. 355(2013), no. 4, 1593-1600, for Brody curves into a complex projective variety in $P^N(\mathbb{C})$ intersecting hypersurfaces.

This is a joining work with Pham Ngoc Mai.

Fermat functional equations

Tuen Wai NG

University of Hong Kong, Hong Kong

The problem of the existence of transcendental meromorphic or entire solutions for the Fermat functional equation $f^n + g^n + h^n = 1$ was first studied by Walter Hayman in 1984. It is known that meromorphic (entire) solutions exist for $n \leq 6$ ($n \leq 5$) and no meromorphic (entire) solution exists when $n \geq 9$ ($n \geq 7$). In this talk we will revisit this problem from a more geometric view point. This is a joint work with Sai-Kee Yeung.

Algebraic and holomorphic flows on Abelian varieties and Hermitian locally symmetric spaces

Emmanuel Ullmo

Institut des Hautes Eútudes Scientifiques, France

I will discuss several results and open problems in the context of "bi-algebraic geometry" where you have a transcendental map relating two algebraic objects. I will focus on the principle of proof of some hyperbolicity results where some Nevanlinna theory is used in combination with o-minimal techniques.

Roots of random functions

Vu Ha Van

Yale University, USA and National University of Singapore, Singapore

The theory of random functions, started by a series of papers of Littlewood-Offord and Kac in the 1940s, is an important topic in many fields of mathematics, including analysis, probability, mathematical physics, and numerical analysis. The main object of the theory is to understand the distribution and interaction among the roots (both complex and real) of the function.

In this talk, we first give a brief introduction to the theory, and then discuss a recent progress (obtained with T. Tao, Y. Do, and O. Nguyen) which gives a complete solution to the distribution problem at local scale, for a large ensemble of random functions, including the two most important classes: random Taylor and random Fourier series.

Applications of Nevanlinna's Theory to Functional Equations.

Chung-Chun Yang

Nanjing University, People's Republic of China

In the talk, some unsolved old conjectures (mainly posed by the speaker over past decades) that related to factorization and value sharing of meromorphic functions, along with their backgrounds and progresses, will be surveyed. Moreover, some relatively new results and conjectures relating to meromorphic solutions of various types of nonlinear differential or difference equations, as well as functional equations of Diophantine type will be reported, for further studies.

Chern forms of metrics with analytic singularities

Elizabeth Wulcan

Chalmers University of Technology, Sweden

In a recent paper Lärkäng, Raufi, Ruppenthal, and Sera constructed Chern forms, or rather currents, $c_k(E, h)$ associated with a Griffiths positive singular

metric h on a holomorphic vector bundle E, that is non-degenerate outside a variety of codimension at least k.

I will discuss a joint work in progress with Lärkäng, Raufi, and Sera, where we define Chern forms for any k in the case when h has analytic singularities. Our construction uses a generalized Monge-Ampère operator for plurisubharmonic functions with analytic singularities, recently introduced by Andersson and me. Moreover our Chern forms coincide with the Lärkäng-Raufi-Ruppenthal-Sera $c_k(E,h)$ when these are defined.

Polarized endomorphisms of normal projective threefolds in arbitrary characteristic

De-Qi Zhang

National University of Singapore, Singapore

Let X be a projective variety over an algebraically closed field k of arbitrary characteristic p. A surjective endomorphism f of X is $q-$ polarized if $f^*H = qH$ for some ample Cartier divisor H and integer $q > 1$.

When f is separable and X is $Q-$Gorenstein and normal, we show that the anti-canonical divisor - K_X is numerically equivalent to an effective $Q-$Cartier divisor, strengthening slightly a result of Boucksom, de Fernex and Favre and also covering singular varieties over an algebraically closed field of arbitrary characteristic.

When f is tame and $p > 5$, we show that one can run the minimal model program (MMP) f-equivariantly for a mildly singular threefold X and reach a variety Y with torsion canonical divisor (and also with Y being a quasi-etale quotient of an abelian variety when $dim(Y) < 3$).

Along the way, we show that a power of f acts as a scalar multiplication on the Neron-Severi group of X when X is a smooth and rationally chain connected of dim $X < 4$.

Suppose X is a normal projective variety with a polarized separable endomorphism f. We show that the Albanese morphism of X is an algebraic fibre space and f induces polarized endomorphisms on the Albanese and also the Picard variety of X, and K_X being pseudo-effective and Q-Cartier means being a torsion Q-divisor.

This is a joint work with Sheng Meng.

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