

Eastern Illinois Integrated Conference in
Geometry, Dynamics, and Topology:
Abstracts

April 7-9, 2017

Vitaly Bergelson (Ohio State)
**Ergodic Ramsey theory: the meeting point of
combinatorics and dynamics**

Friday, April 7 at 4:00pm in Room 1205.

The goal of this talk is to provide a glimpse into the far reaching and mutually perpetuating connections between combinatorics, number theory, ergodic theory and topological dynamics.

Joanna Furno, (IUPUI)
**One-sided ergodic Hilbert transforms for circle
rotations by Liouville numbers**

Saturday, April 8 at 9:00am in Room 1205.

In joint work with David Constantine, we examine one-sided ergodic Hilbert transforms for irrational circle rotations and some mean-zero functions. Most previous results in this area use harmonic analysis and conclude almost-everywhere convergence or divergence. Our approach is more geometric and uses continued fraction expansions to specify Liouville rotations for which there is everywhere convergence or divergence.

Andres Perico (UCSC)
A special case of sub-Riemannian loops

Saturday, April 8 at 10:00am in Room 1205.

Roughly speaking, a sub-Riemannian manifold is a Riemannian manifold together with a constrain on admissible direction of movements. I will present main ideas in some recent results about the length of sub-Riemannian geodesic loops in a semi-simple, connected, compact Lie group. Much of this is based in a 2017 paper by Domokos et al, where they use the geometric information encoded in the root system of the group to describe properties of sub-Riemannian geodesics. I'll show the calculations of the length for sub-Riemannian geodesic-loops in $SU(2)$ and $SU(3)$.

Johann Gaebler (Harvard)

Partially bounded transformations have trivial centralizer

Saturday, April 8 at 10:00am in Room 3040.

We prove that for infinite rank-one transformations satisfying a property called “partial boundedness,” the only commuting transformations are powers of the original transformation. This shows that a large class of infinite measure-preserving rank-one transformations with bounded cuts have trivial centralizer. We also characterize when partially bounded transformations are isomorphic to their inverse.

Meagan Carney (Houston)

Dynamical Borel-Cantelli lemmas and rates of growth of Birkhoff sums of non-integrable observables on chaotic dynamical systems

Saturday, April 8 at 11:10am in Room 1205.

We consider implications of dynamical Borel-Cantelli lemmas for rates of growth of Birkhoff sums of non-integrable observables $\phi(x) = d(x, q)^{-k}$, $k > 0$, on ergodic dynamical systems (T, X, μ) where $\mu(X) = 1$. Some general results are given as well as some more concrete examples involving non-uniformly expanding maps, intermittent type maps as well as uniformly hyperbolic systems.

Gabriel Martins (UCSC)

Magnetic traps in 2 dimensions

Saturday, April 8 at 11:10am in Room 3040.

We study the motion of a charged particle in a bounded region in the plane under the influence of a magnetic field. We show that as long as the field diverges to infinity “fast enough” at the boundary, the particle cannot reach the boundary in finite time. As a corollary we obtain that the magnetic flow of the field is complete. We then analyze a completely integrable example for which the classical system is complete but its analogous quantum system is not.

Brian Benson (Kansas State)– Geometry as seen by the Laplace differential operator

Saturday, April 8 at 1:40pm in Room 1205.

The Laplace differential operator for real, twice differentiable functions of Euclidean space is used in differential equations which model many physical phenomena including gravitational and electric potentials, heat diffusion, and wave propagation, among many others. This operator has a natural extension to the more abstract setting of Riemannian manifolds, where it provides information about the geometry of the manifold. I will discuss work related to this area. Time permitting, I will also show how analogous results can be found for discrete graphs.

Chris Judge (Indiana) Bounding the spectra of homogeneous spaces

Saturday, April 8 at 3:00pm in Room 1205.

The gradient is the most basic operator in geometry and physics. The singular values of this operator may loosely interpreted as the energy levels of a quantum particle freely traveling in the underlying space. In this talk, I will describe new lower bounds on these singular values for spaces whose isometry group acts transitively.

Sugata Mondal (Indiana)– Length and angle spectrum of hyperbolic surfaces

Sunday, April 9 at 9:00am in Room 1205.

Lengths of closed geodesics, length spectrum (marked/unmarked) of negatively curved surfaces are well studied objects. This talk would involve the collection of angles between pairs of these geodesics, angle spectrum. The goal of this talk would be to explain a few properties of this collection.

Byron Heersink (UIUC) Effective equidistribution of preimages of iterates of the Farey map

Sunday, April 9 at 10:00am in Room 1205.

Using techniques from infinite ergodic theory, Kessebohmer and Stratmann proved equidistribution results for sets of the form $F^{-n}([\alpha, \beta])$, where $[\alpha, \beta] \subseteq (0, 1]$ and F is the Farey map, as well as weighted subsets of the Stern-Brocot sequence. This talk presents effective versions of these results, employing certain properties of the transfer operator of the Farey map and Freuds effective version of Karamatas Tauberian theorem. We will focus primarily on a special case which establishes an effective estimate for the Lebesgue measure of the sum-level sets for continued fractions.

Steven Flynn (UCSC) X-rays and Heisenberg

Sunday, April 9 at 10:00am in Room 3040.

I will give the definition of a Sub-Riemannian Geometry with the Heisenberg group as the most basic nontrivial example. The Heisenberg group lets one rephrase the isoperimetric problem of finding the maximum area contained by a fixed boundary length, to finding geodesics of a Sub-Riemannian metric. I will discuss how the X-ray transform, defined for lines in Euclidean space, can be adapted to geodesics on the Heisenberg group, and what kinds of questions we can ask.

Scott Rexford (Northern Illinois)
Searching for geodesics in non-flat infinite dimensional manifolds.

Sunday, April 9 at 11:10am in Room 1205.

We consider submanifolds of Sobolev spaces that arise as level sets of non-linear functionals. In particular, a case where the elements of the submanifold correspond to turning angles of a family of planar curves is considered. Given a functional, computing the gradient of the functional with respect to a given inner product on L^2 or H^1 , a geodesic equation can be derived. In certain instances it is known that geodesics exist solving both initial value problems and boundary value problems, such as in the L^2 sphere, with additional constraints, but there is not a wealth of examples. Perhaps of aesthetic interest, for the usual L^2 inner product under a functional considered, the geodesic equation resembles a pendulum equation. In this talk I will discuss the general setting, and several approaches to establishing existence of solutions, to producing examples (via construction or variational techniques), and also discretization of the geodesic equation in these manifolds.

Renato Feres (Washington University in St. Louis)
Geometry and dynamics of no-slip billiards

Sunday, April 9 at Noon in Room 1205.

We extend earlier results by Gutkin and Wojtkowski on billiard systems known as no-slip. These types of billiards are natural alternatives to the standard kind in which collisions are defined in terms of specular reflection. We indicate how they are derived from a differential geometric classification of rigid bodies collisions in general dimension and, in dimension 2, show some of the dynamical features that set them apart from standard billiards.