Joseph Coffey

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Research Interests

- Symplectic/contact topology, low dimensional topology, algebraic topology
- Specific Interests: holomorphic curves, convex surfaces, foliations, algebraic topology of the symplectomorphism group and related spaces.

Experience

Stanford University, Postdoctoral Fellow 2005-present

NSF Postdoctoral Fellow, Courant Institute for the Mathematical Sciences, 2002-2005

Institute Haute Etude Scientifique, Visiting Researcher, winter 2002, 2003

Education

SUNY - Stony Brook, PhD in Mathematics, December 2002

Advisors Dusa McDuff and Dennis Sullivan.

Thesis: "A symplectic Alexander trick, and spaces of maps with symplectic graphs"

UC - Berkeley, A.B in Mathematics with Honors, 1996

Selected Awards, Grants and Honors

NSF Postdoctoral Fellow, 2002-2005

University Fellow, SUNY- Stony Brook 1996-2001

Letters of Reference

Dusa McDuff dusa@math.sunysb.edu,
Helmut Hofer hofer@cims.nyu.edu
Blaine Lawson blaine@math.sunsyb.edu
Dennis Sullivan kduhart@gc.cuny.edu
Yakov Eliashberg eliash@math.stanford.edu
Richard Hind Hind1@nd.edu
Esteban Tabak (Teaching Reference) tabak@math.nyu.edu

The complete contact information for these referrers is available on the attached AMS cover sheet.

Teaching Experience

Stanford University Fall 2005

- Lectured first year graduate course in complex analysis

NYU/Courant Institute 2002-2005

- Lectured courses in Pre-Calculus, Business Calculus, Calculus I

SUNY Stony Brook, 1997-2001

- Lectured Pre-calculus course
- Teaching Assistant for 4 one variable calculus courses (Business calculus through Honors Calculus), multi-variable calculus, differential equations

- Performed department commissioned review of Math Placement Exam. (The exam decides which students take which courses)
- Over 400 hours tutoring students of all levels (pure algebra through upper division courses)

Berkeley High, 1995

- Teaching Assistant for 2 high school physics classes as part of UC Berkeley Education class

Selected Lectures

1. *Lefschetz pencils and symplectomorphism groups,* SUNY -- Stony Brook Geometry- Topology Seminar, 2002
2. *Symplectomorphism groups of 4-manifolds*, SUNY -- Stony Brook Geometry - Topology Seminar, March 2002
3. *Maps with symplectic graphs,* Geometry Seminar, Instituto- Technico, Lisbon, Portugal, October 2002
4. *Maps with symplectic graphs,* Courant-Stony Brook, Joint Symplectic Seminar, January 2003
5. *Measured J-holomorphic foliations*, Courant Symplectic Seminar,
6. *Failure of the parametric h-principle for maps with prescribed Jacobian,* AMS regional meeting, Los Angeles, CA, February 2004
7. *Failure of the parametric h-principle for maps with prescribed Jacobian,* Columbia Gauge Theory Seminar, October 2004
8. *Failure of the parametric h-principle for maps with prescribed Jacobian,* Tulane University Geometry Seminar, April 2005
9. *Failure of the parametric h-principle for maps with prescribed Jacobian,* USC Geometry seminar, May 2005
10. *Failure of the parametric h-principle for maps with prescribed Jacobian,* Stanford, Symplectic seminar, October 2005

Publications and preprints

For a description of each paper see the attached Research Statement. The full text of each paper is available on my website math.nyu.edu/~coffey

Symplectomorphism groups and isotropic skeletons, *Geomtery and Topology,* 9:935–970 (electronic), 2005.

The homotopy type of the diffeomorphism group of a surface is determined by its action on a filling system of curves. This paper gives a symplectic generalization of this statement to dimension 4. We then use this generalization to give the first computation of the full homotopy type of Lagrangian embeddings for closed domain and range, It has since inspired a sequence of papers by R. Hind and A. Ivirii.

Failure of the parametric *h*-principle for maps with prescribed Jacobian submitted for publication.

In 1973 Eliashberg and Gromov showed that maps with prescribed Jacobian satisfy an *h*-principle, and thus there is no interesting geometry in the existence of solutions. In this paper we show that, surprisingly, the corresponding parametric *h*-principle fails, and thus there is interesting topology in the space of solutions. Maps with prescribed Jacobian thus lie in between soft and hard mathematics, blessed with both many examples, and interesting structure.

Spaces of maps with symplectic graphs, math.SG/0407221 submitted for publication

Spaces of rational maps of CP^1 to itself have admitted a long and fruitful study. One can view such a map either as a map preserving a complex structure, or as a map whose graph is a complex submanifold. In this paper we take this second viewpoint, and consider maps whose graphs are symplectic manifolds. We show that such maps have a natural topological model in terms of maps with bounded surjectivity. Using this characterization we show that the dependence of the topology of this space on the forms is quantized, it jumps as we pass certain walls in the deformation space. This quantization is reminiscent of that of the Symplectomorphism groups of ruled surfaces, discovered by Gromov, Abreu and McDuff.

Moreover we give complete computations of these spaces in some examples, and show that there topology can be quite complicated. Finally we prove certain identities, and leverage these with the theory of J-holomorphic curves to show that the space of symplectic sections of a symplectic fibration has a homotopy type which changes as we deform the fibration.

Measured J-holomorphic foliations, preprint, available at math.nyu.edu/~coffey

This paper considers possible generalizations of the Narisham-Seshadri Theorem to almost complex structures on a sphere bundle over a surface. We show that a naive generalization fails: there are almost complex structures for which there can be no holomorphic foliation with an invariant metric. We then show a uniqueness theorem for holomorphic foliations with invariant measure (in this context) and then prove an existence theorem for a weaker object - cycles given by measured families of complex planes using Sullivan's Hahn-Banach alternative.

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