

Geometry and dynamics of maps on flat surfaces and metric graphs

Project summary

The aim of this project is to explore the relationship between Teichmüller dynamics, 3-manifold topology, and the geometry of outer space in the study of maps on translation surfaces and metric graphs built from various covering and limiting construction. Some of the questions currently being studied by Wu and his collaborators in this direction include the generalization of Teichmüller polynomial [1] to maps on infinite flat surface and metric graphs, the asymptotic estimate of translation lengths of graph maps with homotopic mapping torus, and the estimate of spectral radius of the induced maps on the L^2 cohomology of surfaces and graphs.

Intellectual merit

Wu and his collaborators have previously carried out computations on the affine group action on the Abelian cover of flat polowcases in [2], studied the topology of infinite translation surfaces in [3], studied the construction of interesting pseudo-Anosov maps in [4] and also calculated their Teichmüller polynomials, proved an analogous version of the Kazhdan's theorem for metric graphs as well as higher dimensional simplicial complexes, and also recently established an upper bound for the translation length in the curve complexes for pseudo-Anosov maps that correspond to primitive lattice points in the same fibered cone of a hyperbolic 3-manifold. Many questions in the current project are motivated by these prior works.

Furthermore, some preliminary results have already been obtained regarding the goals of this project: many interesting examples of affine maps on infinite flat surfaces have been found and studied, and the method of computing the Teichmüller polynomials of surfaces constructed in [3] is being generalized to pseudo-Anosov maps obtained through a covering construction or defined on surfaces with punctures. These will be described in more details in the project description section.

Broader impact

Both flat surfaces and metric graphs are connected to important mathematical questions in Teichmüller theory, geometric group theory and low dimensional topology, and have many applications in numerical analysis, statistics and engineering, and it is hoped that the ideas and algorithms developed in this project would be useful in these fields.

Project description

References

- [1] C. T. McMullen, Polynomial invariants for fibered 3-manifolds and Teichmüller geodesics for foliations. *Annales scientifiques de l'Ecole normale supérieure*. 33(4), 2000.
- [2] C. Wu. The relative cohomology of abelian covers of the flat pillowcase. *Journal of Modern Dynamics* 9:123-140, 2015.
- [3] H. Baik, A. Rafiqi, and C. Wu. Constructing pseudo-Anosov maps with given dilatations. *Geometriae Dedicata*, 180(1), 39-48. 180(1):39-48, 2016
- [4] L. Clavier, A. Randecker, and C. Wu. Rotational component spaces for infinite-type translation surfaces. *arXiv preprint* arXiv:1412.0633, 2014.

Biographic sketch

Education and Employment

B. Sc. in Mathematics, Peking university	July 2010.
Ph. D in Mathematics, Cornell university	August 2016.
Advisor: John Smillie	
Thesis: Translation surfaces: saddle connections, triangles and covering constructions	
Member of MSRI	August 2016-Oct 2016
Postdoc at MPIM	Nov 2016-July 2017
Hill Assistant Professor at Rutgers	September 2017-

Publications

- Chenxi Wu. The relative cohomology of abelian covers of the flat pillowcase. *Journal of Modern Dynamics*, doi:10.3934/jmd.2015.9.123
- Chenxi Wu. Deloné property of the holonomy vectors of translation surfaces. *Israel Journal of Mathematics*, doi: 10.1007/s11856-016-1357-y
- Hyungryul Baik, Ahmad Rafiqi and Chenxi Wu. Constructing pseudo-Anosov maps with given dilatations. *Geometriae Dedicata*, doi: 10.1007/s10711-015-0089-1
- Chenxi Wu. Lattice surfaces and smallest triangle. *Geometriae Dedicata*, doi: 10.1007/s10711-016-0191-z

Preprints

- Hyungryul Baik, Ahmad Rafiqi and Chenxi Wu. Is a typical bi-Perron number a pseudo-Anosov dilatation? *arXiv*: 1612.03084 (To appear in *Ergodic Theory and Dynamical Systems*)
- Lucien Clavier, Anja Randecker and Chenxi Wu. Rotational component spaces for infinite-type translation surfaces. *arXiv*: 1412.0633
- Hyungryul Baik and Chenxi Wu. An algorithm to compute Teichmüller polynomial from matrices *arXiv*: 1703.09089

Other works in preparation

- Hyungryul Baik, Ahmad Rafiqi and Chenxi Wu. Approximations to infinite type pseudo-Anosov maps
- Farbod Shokrieh and Chenxi Wu. A Kazhdan-type theorem for metric graphs
- Yingjie Guo, Chenxi Wu, Ao Li etc. A gene-based permuted extreme gradient boost method for detecting gene-gene interaction of qualitative traits
- Hyungryul Baik, Farbod Shokrieh and Chenxi Wu. Kazhdan's theorem for Riemann surfaces, manifolds and complexes

Grants

AMS MRC	Summer 2017
KHYS Visiting Researcher Scholarship	Summer 2014
Graduate Fellowship, Cornell University	2010-2011