# Workshop: Topology and Computer 2013

November 29–December 1, 2013
Meiji University, Nakano Campus

## Schedule

**Friday, November 29**

13:30–13:40  Opening

13:40–14:10  Akira Yasuhara (Tokyo Gakugei University)
$C_k$-concordance group of $n$-string links (joint work with Jean-Baptiste Meilhan (University of Grenoble I))

14:20–14:50  Yoshimasa Takabatake (Kyushu Institute of Technology)
Efficient computation of Milnor Invariants by Grammar Compression

15:20–16:20  Yasuaki Hiraoka (Kyushu University)
Persistent Homology and its Applications (I)

16:50–17:50  Yuki Igarashi (University of Tsukuba / Meiji Unversity)
Computational Handicraft

18:30–        Banquet

**Saturday, November 30**

9:30–10:00  Saki Nakatsuma (Nara Women's University)
Q-condition and bifurcation locus on character variety

10:10–10:40  Tomoka Tanabe (Nara Women's University)
Geometric free energy of finitely generated Möbius groups

11:00–12:00  Takefumi Nosaka (Kyushu University)
For Lefschetz-fibration invariants, matrix presentations of representations of the mapping class group

12:00–13:30  Lunch

13:30–14:30  Yasuaki Hiraoka (Kyushu University)
Persistent Homology and its Applications (II)

15:00–16:00  Yuichi Kabaya (Osaka University)
Bending deformation of quasi-Fuchsian groups

16:20–17:20  Yasuaki Hiraoka (Kyushu University)
Persistent Homology and its Applications (III)

**Sunday, December 1**

9:30–10:30  Hidetoshi Masai (Tokyo Institute of Technology), Akitoshi Takayasu (Waseda University)
  Verified computations for hyperbolic 3-manifolds

10:50–11:50  Kazuhiro Ichihara (Nihon University)
  Exceptional surgeries on alternating knots

11:50–13:30  Lunch

13:30–14:30  Eiko Kin (Osaka University)
  Monodromies of fibrations on the magic 3-manifold

15:00–16:00  Tetsuya Ito (RIMS, Kyoto University)
  A Garside-theoretical approach for faithfulness question to Burau representations

16:00–16:10  Closing

<div align="right">(Last modified: December 2)</div>

# Abstract

**Akira Yasuhara (Tokyo Gakugei University)**
$C_k$-concordance group of $n$-string links (joint work with Jean-Baptiste Meilhan (University of Grenoble I))

The $C_k$-equivalence is an equivalence relation on $n$-string links which is genarated by $C_k$-move and concordance. The set of $C_k$-concordance classes of $n$-string links has a group structure. We decide when the quotient groups become abelian. In particular, we show that the $C_9$-concordance group of 2-string links is not abelian. The proof relies on a direct computation, using a computer program based on the algorithm given by Milnor to compute $\mu$-invariants.


**Yoshimasa Takabatake (Kyushu Institute of Technology)**
Efficient computation of Milnor Invariants by Grammar Compression

We present a fast and space-efficient algorithm for calculating Milnor invariants.


**Yasuaki Hiraoka (Kyushu University)**
Persistent Homology and its Applications

Persistent homology is a tool for studying robustness of topological features in a filtration of topological spaces. It is defined as a graded module on a polynomial ring $k[x]$ with one variable, where $k$ is a field. From the structure theorem of finite modules on $k[x]$, the persistnet homology has a unique decomposition into indecomposables, and this decomposition encodes information of robustness of topological features as persistent diagrams. The persistent homology can be also treated as a represetation on the $A_n$-quiver. In this talk, we survey the theory and computations of persistent homology, and then generalize them to certain types of quivers. Moreover, several applications on protein structural analysis and material sciences are also discussed.


**Yuki Igarashi (University of Tsukuba / Meiji Unversity)**
Computational Handicraft

Design of original handicrafts requires the construction of an appropriate 2D pattern, but this is very difficult for children and this restricts them to use off-the-shelf 2D patterns only. I introduce some interactive systems that allow nonprofessional users to design their own original handicrafts. I successfully demonstrated in workshops and user studies that children can design original handicrafts using our design support systems.

**Saki Nakatsuma (Nara Women's University)**
Q-condition and bifurcation locus on character variety




**Tomoka Tanabe (Nara Women's University)**
Geometric free energy of finitely generated Möbius groups




**Takefumi Nosaka (Kyushu University)**
For Lefschetz-fibration invariants, matrix presentations of representations of the mapping class group

> A class of Lefschetz fibrations is roughly that of closed 4-manifolds which can be studied from the mapping class group, $\mathcal{M}_g$. Recently I introduced its invariant which is constructed from any representation, $\rho$, of $\mathcal{M}_g$ and any $\mathcal{M}_g$-invariant bilinear form. However to compute the invariant, we need concrete matrix presentations of $\rho$. In this talk, I propose several problems on programs to compute them promptly, and discuss useful (quantum or modular) representations, which are hard to describe by hands.




**Yuichi Kabaya (Osaka University)**
Bending deformation of quasi-Fuchsian groups

> We introduce a program drawing developing maps of some pleated surface associated with $PSL(2, \mathbb{C})$-representations. As an application, we study limits of quasi-Fuchsian groups under bending deformation.

**Hidetoshi Masai (Tokyo Institute of Technology),**
**Akitoshi Takayasu (Waseda University)**
Verified computations for hyperbolic 3-manifolds

For a given cusped 3-manifold $M$ admitting an ideal triangulation, we describe a method to rigorously prove that either $M$ or a filling of $M$ admits a complete hyperbolic structure via verified computer calculations. The key ingredients of our method are interval arithmetic and the Krawczyk Test. These techniques represent an improvement over existing algorithms as they are faster while accounting for error accumulation in a more direct and user friendly way. This work is a joint work with N. Hoffman, K. Ichihara, M. Kashiwagi, and S. Oishi.

**Kazuhiro Ichihara (Nihon University)**
Exceptional surgeries on alternating knots

I will talk about our recent study on exceptional surgeries on alternating knots. Actually, by computer-aided, but rigorous calculation, we give a complete classification of such surgeries. This work is a joint work with H. Masai.

**Eiko Kin (Osaka University)**
Monodromies of fibrations on the magic 3-manifold

By work of Thurston, if a hyperbolic fibered 3-manifold $M$ has the second Betti number more than 1, then it admits infinitely many fibrations on $M$. Moreover the monodromy of any fibration on $M$ is pseudo-Anosov. As an example of such manifolds, we consider the magic 3-manifold which is the complement of a particular link with 3 components. We describe monodromies of fibrations on the magic manifold concretely, and we compute the train track maps associated to the pseudo-Anosov monodromy of each fibration. Our result includes the description of monodromies of fibrations on the manifolds obtained from the magic manifold by Dehn fillings. (For example, the complements of the Whitehead link, Whitehead sister link, Berge link etc.) This is a joint work with Mitsuhiko Takasawa.

**Tetsuya Ito (RIMS, Kyoto University)**
A Garside-theoretical approach for faithfulness question to Burau representations

The question whether the Burau reprsentation of the braid group is faithful or not is still unsolved for the four-strand braid case. In this talk, we explain a relationship between Garside normal form, a certain normal form of braids, and the Burau representation. We also explain several ideas to try to find kernel of Burau representation. This talk is based on a joint work with Matthieu Calvez.