The 10th KOOK-TAPU Joint Seminar on Knots and Related Topics & The 12th Graduate Student Workshop on Mathematics

July 24–26, 2018
Hotel Nongshim, Crystal Room and Sapphire Room (2F),
Dongnae-gu, Busan, Korea

Organizing Committee

Yongju Bae (Kyungpook National University)
Seiichi Kamada (Osaka City University)
Taizo Kanenobu (Osaka City University)
Akio Kawauchi (OCAMI)
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The 10th KOOK-TAPU Joint Seminar on Knots and Related Topics

Abstracts

Tuesday, July 24

Isotopy Classes of Embedded Surfaces in 3-space as a 3-category

Scott Carter (University of South Alabama)

The main result of the talk is a folk-theorem that has been known for about twenty years or more. As it happens, an explicit description and proof has not been given. So here, I will prove the following. The naturally monoidal, strictly 2-pivotal, weakly 3-pivotal, rotationally commutative, strictly 3-tortile 3-category with one object that is freely generated by a weakly self-invertible non-identity 1-morphism is equivalent to the 3-category of isotopy classes of properly embedded surfaces that are embedded in the product of the plane with an interval.

On generating sets of oriented Roseman moves

Kengo Kawamura (OCAMI)

Roseman moves are seven types of local modifications for surface-link diagrams in 3-space which generate ambient isotopies for surface-links in 4-space. They are generalization of three types of Reidemeister moves for link diagrams in 2-plane which generate ambient isotopies for links in 3-space. A (minimal) generating set of oriented Reidemeister moves is introduced by Polyak. In this talk, we introduce a generating set of oriented Roseman moves.

On an enumeration of immersed surface-links

Jieon Kim (Pusan National University)

A surface-link, or an embedded surface-link, is a closed surface embedded in Euclidean 4-space $\mathbb{R}^4$. An immersed surface-link is a closed surface immersed in $\mathbb{R}^4$ such that the multiple points are transverse double points. Surface-links and immersed surface-links can be presented by diagrams on the plane of 4-valent spatial graphs with makers on the vertices, called marked graph diagrams (cf. [1, 2, 4]). K. Yoshikawa consider the enumeration problem of surface-links in Euclidean 4-space $\mathbb{R}^4$. In this paper [3], we consider the enumeration problem of immersed surface-links in $\mathbb{R}^4$.

References

[1] S. Kamada, A. Kawauchi, J. Kim, and S. Y. Lee, Presentation of immersed surface-links by marked graph diagrams. ArXiv e-prints, July 2017.

[2] A. Kawauchi, T. Shibuya, S. Suzuki, Descriptions on surfaces in four-space, I; Normal forms, *Math. Sem. Notes Kobe Univ.* 10 (1982), 75–125.

[3] J. Kim, An enumeration of immersed surface-links in $\mathbb{R}^4$, in preperation.

[4] K. Yoshikawa, An enumeration of surfaces in four-space, *Osaka J. Math.* **31** (1994), 497–522.

Vassiliev knot invariants up to order six derived from cable Γ-polynomials

Hideo Takioka (OCAMI)

For coprime integers $p(>0)$ and q, the (p,q)-cable Γ-polynomial of a knot K is the Γ-polynomial of the (p,q)-cable knot of K, where the Γ-polynomial is the common zeroth coefficient polynomial of the HOMFLYPT and Kauffman polynomials. I will talk about Vassiliev knot invariants up to order six derived from cable Γ-polynomials.

Ford and Dirichlet domains for cone hyperbolic manifolds

Hirotaka Akiyoshi (Osaka City University)

In the study of hyperbolic knots, the canonical decomposition, in the sense of Epstein-Penner, plays an important role, because it is canonically determined from the hyperbolic structure. We look for the counterpart to it for 3-dimensional cone manifolds. The Ford domain is the geometric dual to the canonical decomposition, and so its generalization for cone manifolds will be a candidate, however it is not canonical enough. In this talk we study a family of Dirichlet domains as well as Ford domains, and observe some propeties.

Cluster variables on a braid

Seokbeom Yoon (Seoul National University)

Given a braid presentation D of a hyperbolic knot, Hikami and Inoue consider polynomial equations arising from a sequence of cluster mutations determined by D. They show that any solution to these equations determines a boundary-parabolic $\mathrm{PSL}(2,\mathbb{C})$-representation of the knot group. They also conjecture the existence of solution corresponding to the geometric representation.

In this talk, we will show that a boundary-parabolic representation ρ arises from a solution if and only if the length of D modulo 2 equals the obstruction to lifting ρ to a boundary-parabolic $\mathrm{SL}(2,\mathbb{C})$-representation (an element in $\mathbb{Z}/2$). In particular, the Hikami-Inoue conjecture holds if and only if the length of D is odd. We also explicitly construct the solution corresponding to a boundary-parabolic representation given in the Wirtinger presentation of the knot group. This work is joint with Jinseok Cho and Christian Zickert.

A note on the cross-index of a complete graph based on a linear tree

Yoshiro Yaguchi (National Institute of Technology, Gunma College)

A diagram of a complete graph is a regular projection to the 2-sphere of a spatial embedding of the complete graph. The crossing number of a complete graph is the minimal value of the crossing number for all diagrams. The Guy's formula is known as a conjecture of the crossing number of a complete graph with general number of vertices. In 2013 (and in 2017), it has been proved that Guy's conjecture is true for diagrams with free hamiltonian cycles (and with free linear trees, resp.). In this talk, we show that a complete graph with n vertices has an optimal diagram, namely a diagram whose crossing number equals the value of Guy's formula, with a free maximal linear tree and without free hamiltonian cycles for any odd integer $n \geq 7$. This is a joint work with Yusuke Gokan, Hayato Katsumata, Katsuya Nakajima and Ayaka Shimizu.

An unknotting number on inverse-half-twisted splices for knot projections and knots

Ayaka Shimizu (National Institute of Technology, Gunma College)

The inverse-half-twisted splice on a knot projection is a splice at a crossing which preserves the component number. In this talk, we define an unknotting number on this splice for knot projections, which has the additivity on connected sums and is preserved by flypes. We also discuss about some knot invariants.

Wednesday, July 25

Virtual Tribrackets and Niebrzydowski Algebras

Sam Nelson (Claremont McKenna College)

Tribrackets are sets with ternary operations motivated by region colorings of Reidemeister moves. In this talk we will collect results from two recent projects, defining region coloring structures for oriented virtual knots and links and for Y-oriented trivalent spatial graphs and handlebody-links. This is joint work with undergrad students Shane Pico (Claremont McKenna College) and Paige Graves (University of La Verne) and PhD student Sherrilyn Tamagawa (University of California, Santa Barbara).

On virtual links which are equivalent as twisted links

Seiichi Kamada (Osaka City University)

A virtual link is a generalization of a classical link that is defined as an equivalence class of certain diagrams, called virtual link diagrams. It is further generalized to a twisted link. Twisted links are in one-to-one correspondence with stable equivalence classes of links in oriented thickenings of (possibly non-orientable) closed surfaces. By definition, equivalent virtual links are also equivalent as twisted links. In this paper, we discuss when two virtual links are equivalent as twisted links, and give a necessary and sufficient condition for this to be the case. This is a joint work with Naoko Kamada.

The generalized Alexander polynomial of virtual periodic links

Joonoh Kim (Pusan National University)

In this paper we give several simple criteria to detect possible periods and linking numbers for a given virtual link. We investigate the behavior of the generalized Alexander polynomial ZL of a periodic virtual link L via its Yang-Baxter state model given in [1].

References

[1] L. H. Kauffman, D. E. Radford, Bi-oriented quantum algebras and a generalized Alexander polynomial for virtual links, in Diagrammatic morphisms and applications, Contemp. Math., 318 (2003), pp. 113-140.

Coverings of virtual links based on mod p Alexander numbering

Naoko Kamada (Nagoya City University)

A virtual link is called almost classical if there is a diagram which admits Alexander numbering. A virtual link is called mod p Alexander numberable if there is a diagram which admits mod p Alexander numbering. We introduce a method constructing a mod p Alexander numberable virtual link diagram D_p from any virtual link diagram D and show that if D and D represent the same virtual link then $D(p)$ and $D(p)$ represent the same mod p Alexander numberable virtual link. Thus we have a map from the set of virtual links to that of mod p Alexander numberable virtual links.

Goussarov-Polyak-Viros finite type invariant and a local move on virtual knots

Yuka Kotorii (RIKEN)

A C_n-moves are a family of local moves on knots, which gives a topological characterization of finite type invariants of knots. Stanford reconstructed these moves by using the lower central series of the the pure braid group. In this talk, we extend this reconstruction to (long) virtual knots. We then prove that for long virtual knots an equivalence relation generated by our moves is equal to n-equivalence, which is an equivalence relation on (long) virtual knots defined by Goussarov, Polyak and Viro. As a corollary, we give that two long virtual knots are not distinguished by any Goussarov-Polyak-Viros finite type invariants of degree $n-1$ if they are translated by our moves of degree n, for any positive integer n.

On knotoids and its invariants

Sera Kim (Pusan National University)

Turaev introduced the theory of knotoids and gave some invariants for knotoids. A (classical) *knotoid diagram* in S^2 is an open ended knot diagram. It forms a new diagrammatic theory that is an extension of classical knot theory. *Gügümcü* and Kauffman improved the theory of knotoids and virtual knotoids so that many classical invariants of knots and links can be applied for knotoids in S^2, and defined the affine index polynomial for knotoids and virtual knotoids. In this talk, we introduce new polynomial invariants for knotoids and virtual knotoids. Also we discuss the solution of Kauffman's conjecture on knotoids.

On generalization of Conway algebra to construct a link invariant with two skein relations

Seongjeong Kim (Bauman Moscow State Technical University)

In [1] J.H.Przytyski and P.Traczyk introduced an algebraic structure, which is called *a Conway algebra,* and constructed an invariant of oriented links valued in the Conway algebra, which gives the Homflypt polynomial invariant. In this talk we talk about a generalization of Conway algebra to construct link invariant with two skein relations, which is a generalization of Homflypt polynomial invariant.

References

[1] J.H.Przytyski, P.Traczyk, *Invariants of links of Conway type,* Kobe Journal of Mathematics, 4 (1989) 115-139.

On a generalization of Conway algebra for links or surface-links

Seonmi Choi (Kyungpook National University)

Przytyski and Traczyk introduced a Conway algebra, which gives the Homflypt polynomial invariant. In 2018, Kim introduced a generalized Conway algebra and constructed an invariant with two different skein relation. In this talk, we will introduce generalizations of Conway algebra for links or surface-links. In particular, we will define generalizations of Conway algebra for surface-links via marked graph diagrams.

Thursday, July 26

Groups G_n^k and invariants of topological spaces

Vassily O. Manturov (Bauman Moscow State Technical University)

In 2015, the author defined groups G_n^k depending on two natural parameters, n and k, and formulated the following principle:

If dynamical systems describing n particles possess a good codimension 1 property governed by exactly k particles then they have topological invariants valued in G_n^k.

The first examples were maps from the pure braid groups to the groups G_n^3 and G_n^4 with respect to the properties "three points are collinear" or "four points belong to the same circle/line".

In the initial formulation, particles need not necessarily be points. One can easily consider n points on the projective space and use projective duality to get n projective hyperplanes.

This predicts the behaviour of n particles in general situation: we can have n subspaces of codimension 1 in some topological space; if their intersection is good then there is a map from the fundamental group of the corresponding (connected component of) moduli space to the group G_n^{k+1}.

This allows one to study manifolds of any dimension by taking submanifolds and mapping the corresponding fudnamental groups to G_n^{k+1}.

Twisted Alexander polynomial of a ribbon 2-knot of 1-fusion

Taizo Kanenobu (Osaka City University)

In general, the twisted Alexander polynomial is a rational function, not necessarily a polynomial. It is shown that for a ribbon 2-knot of 1-fusion, the twisted Alexander polynomial associated to a irreducible representation of the knot group to SL(2; F) is always a polynomial, and if the knot is fibered then it is monic.

On a stably trivial surface-knot

Akio Kawauchi (OCAMI)

It is explained how a stably trivial surface-knot is a ribbon surface-knot.

The 12th Graduate Student Workshop on Mathematics

Abstracts

Tuesday, July 24

On a classification of twisted knots with 3 classical crossings

Kaori Okubo (Nagoya City University)

A twisted link is an extension of a virtual knot, which is based on a link diagram on a (possibly non-orientable) surface.It was introduced by Bourgoin. In this talk we discuss a table of twisted knots with 3 classical crossings.

A construction of invariants for surface links via the Arf invariant

Minju Seo*, J. Kim and S. Y. Lee (Pusan National University)

A surface-link is a closed 2-manifold smoothly embedded in 4-space. A method of constructing invariants for surface-links was introduced by S. Y. Lee which uses a state-sum model with invariants for classical knot and links in $\mathbb{R}^3$ based on marked graph diagram presentation of surface-links.
In this talk, we would like to introduce the Numerical link type invariant and examine the construction using the Numerical link type invariant for classical oriented knots and links in $\mathbb{R}^3$. This is a joint work with J. Kim and S. Y. Lee.

On invariants for surface-links using the HOMFLY-PT polynomial

Suhyeon Jeong*, J. Kim and S. Y. Lee (Pusan National University)

A surface-link (or knotted surface) is a closed 2-manifold smoothly embedded in $\mathbb{R}^4$ or S^4. S. Y. Lee introduced a method of constructing invariants for surface-links using a state-sum model with invariants for classical knots and links in $\mathbb{R}^3$ based on marked graph diagram presentation of surface-links.
In this talk, we would like to examine the construction using the HOMFLY-PT polynomial invariant for classical oriented knots and links in $\mathbb{R}^3$ and derive new invariants for oriented surface-links in $\mathbb{R}^4$. This is a joint work with J. Kim and S. Y. Lee.

Sharp Hardy-Leray inequality for vector-valued functions with differential constraints

Naoki Hamamoto (Osaka City University)

Hardy inequality is one of the famous functional inequalities for real-valued functions and it has applications in physics or developments in mathematical analysis. In 2008 O.Costin and V.Maz'ya proposed Hardy inequality for vector-valued functions with divergence-free. Using analytical methods including spectral analysis, they proved that the restriction of divergence-free can improve the constant factor in Hardy inequality. We show that their idea can also be developed for curl-free vector fields.

A revised mathematical modeling of atopic dermatitis

Yoseb Kang (Kyungpook National University)

In this talk, we give a motivation how we have to research atopic dermatitis based on mathematical model and its aspects. Based on R. Tanaka's work who gives a well established mathematical model of atopic dermatitis at the first time, we show a develped mathematical model considering more key factors related with this disease such as Allergens, Itch-Scratch cycle, etc. The research goal in this area is to define dynamic systems or mechanisms of atopic dermatitis. We hope that our model helps people to predict how worse it will be and suggest each patient what type of treatment is good.

Green's functions for Laplacian

Teruya Matsuura (Osaka City University)

In this talk, we discuss Green's function for the Laplace operator on various domains.

Common surfaces with zero mean curvature in $\mathbb{L}^3$ and $\mathbb{E}^3$

Hoyoung Jeong (Pusan National University)

We consider two metrics $ds^2 = ds_0^2 + dt^2$ and $\widetilde{ds}^2 = ds_0^2 - dt^2$ on $M \times \mathbb{R}$ where (M, ds_0^2) is a riemannian manifold. We find hypersurfaces in $M \times \mathbb{R}$ have the mean curvature of 0 with respect to ds^2 and $\widetilde{ds}^2$ at the same time, except for hyperplanes. O. Kobayashi(1983) published that only the helicoid is the hypersurface that satisfies the condition in $\mathbb{R}^3$. Y. W. Kim, S. E. Koh, H. Y. Shin, and S. D. Yang(2009) tried this in the case that M is a 2-dimensional Riemannian manifold and got the similar results. I tried this in the case that M is a higher dimensional Euclidean space.

Geometrization of 2-dimensional orbifolds

Ryoya Kai (Osaka City University)

It is known that most of the 2-dimensional orbifolds have geometric structures. The structures are decided by the Euler number for orbifolds. Moreover, most of them have hyperbolic structures. Following Thurston's lecture note, we will see how to construct a hyperbolic structure on the 2-orbifold.

A survey on infinite dimensional symmetric spaces and polar actions

Masahiro Morimoto (Osaka City University)

Symmetric spaces are introduced by E. Cartan in 1920s, and they are also known as an important class of Riemannian manifolds in connection with polar actions. In this talk I shall give a survey on an infinite dimensional version of symmetric spaces, which is called an affine Kac-Moody symmetric space, and emphasis on the relation of such infinite dimensional symmetric spaces with the polar actions on Hilbert spaces.

Noetherian properties on Generalized composite Hurwitz rings

Dong Kyu Kim (Kyungpook National University)

Let $\mathcal{R} = (R_n)_{n\geq 0}$ be an ascending chain of commutative rings with identity and $\mathrm{H}(\mathcal{R})$ (resp., $\mathrm{h}(\mathcal{R})$) the generalized composite Hurwitz series ring (resp., generalized composite Hurwitz polynomial ring). In this talk, we give equivalent conditions for the rings $\mathrm{H}(\mathcal{R})$ and $\mathrm{h}(\mathcal{R})$ to be Noetherian rings.

Parabolic group and flag varieties

Masashi Noji (Osaka City University)

The flag variety in a finite dimensional vector space V is set of flags of V. A flag of V is an increasing sequence of subspaces in V. Representations of general linear groups gives a parabolic group. By using this group, we can present the flag variety in terms of group theory. In this talk, I introduce this presentation of flag variety.

On the Translation Equivalence in a Free Group of Higher Rank

Sooa Song (Pusan National University)

Let F_n be a free group of rank $n \geqslant 2$. Two words $g, h \in F_n$ are called *translation equivalent* in F_n if the cyclic length of $\phi(g)$ equals the cyclic length of $\phi(h)$ for every automorphism ϕ of F_n. We consither how to decide that given two elements g, h in a free group which rank is higer than 2 are translation equivalent.

Wednesday, July 25

Counting walks in a graph

Miho Shibutani (Osaka City University)

In a graph G, a sequence $v_1, e_1, v_2, e_2, \ldots, e_n, v_{n+1}$ is called a walk of length n, where each e_i $(i = 1, 2, \ldots, n)$ is an edge of G with v_i and v_{i+1} as endpoints. In this talk, we count walks of length n for some graphs.

Finding a path between two colourings

Jae-baek Lee (Kyungpook National University)

For a fixed graph H, the recolouring problem for H-colouring(i.e. homomorphisms to H) ask: given a graph G and two H-colourings ϕ and ψ of G, is it possible to transform ϕ into ψ by changing the colour of one vertex at a time such that all intermediate mappings are H-colourings. This is equivalent to asking whether there exists a sequence $f_0, \ldots, f_m$ of H-colourings such that $f_0 = \varphi$, $f_m = \psi$ and $f_i(u)f_{i+1}(v) \in E(H)$ for every $0 \leq i < m$ and $uv \in E(G)$?
This is joint work with Rick Brewster, Mark Siggers, Benjamin Moore and Jonathan Noel.

Polytopes in $\mathbb{R}^4$ which we can see

Kosuke Doi (Osaka City University)

There are polytopes which are sitting in $\mathbb{R}^4$ but we can see. In this talk I will introduce some of them.

Recovering Partial Differential Equations by Compressive Sensing

Gyuyeop Kim (Kyungpook National University)

In 2011, Wen-Xu.Wang, Rui Yang, Ying-Cheng Lai et al. have studied the method of recovering ordinary differential equation systems based on compressive sensing scheme. In this talk, from randomly extracted spatiotemporal data, we will show how we used compressive sensing scheme to recover partial differential equation systems and the results.

Gagliardo-Nirenberg-Sobolev inequality and isoperimetric inequality

Kazuya Akayama (Osaka City University)

Gagliardo-Nirenberg-Sobolev inequality is an analytic inequality and isoperimetric inequality is a geometric inequality. In this talk, we show that these are equivalent and moreover, we obtain the best constant of the former in $p = 1$ case.

Integral formula for the confluent hypergeometric function of the first kind

Hong Rae Cho, Hyunil Choi* and Han-Wool Lee (Pusan National University)

In this talk, we derive a new integral formula for the confluent hypergeometric function of the first kind by using some fractional operator and, as a result, we have a size estimate for the confluent hypergeometric function of the first kind via the integral formula.

Color break number of links

Byeorhi Kim (Kyungpook National University)

Given a quandle, the set of all links is divided into two subsets, colorable and non-colorable. If a link L is non-colorable by a quandle Q, then there are some color break points in a diagram D of L, whenever one colors D by Q. In this talk, we will discuss about the number of such color break points of links.

On G-family of quandles

Misaki Kataoka (Nara Women's University)

A quandle is an algebraic system whose axioms are motivated by local moves of knot diagrams. In 2013, Ishii-Iwakiri-Jang-Oshiro introduced the notion of G-family of quandles which is an algebraic system whose axioms are motivated by local moves of handlebodies embedded in the 3-sphere, called handlebody-knots. In this talk, we will explain how to construct invariants for handlebody-knots using G-family of quandles, and show an example of handlebody-knot that can be distinguished from its mirror image by using the invariants.

$(1,1)$-diagrams of $(1,1)$-knots up to 10 crossings and $(1,1)$-pretzel knots

Geunyoung Kim (Pusan National University)

A knot K in S^3 is called a $(1,1)$-knot if it admits a decomposition of the pair (S^3, K) into a union $(S^3, K) = (V_1, K_1) \cup (V_2, K_2)$, where $V_1 \cup V_2$ is a genus one Heegaard splitting of S^3 and K_1 and K_2 are properly embedded trivial arcs in V_1 and V_2, respectively, with $K = K_1 \cup K_2$. A $(1,1)$-knot in S^3 is represented by a $(1,1)$-diagram $D(a,b,c,r)$, where a, b, c, and r are nonnegative integers. In this talk, we introduce an algorithm for finding a $(1,1)$-diagram by using a $(1,1)$-tunnel of a given $(1,1)$-knot and an algorithm for finding dual $(1,1)$-diagram of a given $(1,1)$-diagram. We present a list of $(1,1)$-diagrams of all $(1,1)$-knots up to 10 crossings in Rolfsen's knot table and their dual $(1,1)$-diagrams. Also, we find an explicit form of $(1,1)$-diagrams of all $(1,1)$-pretzel knots.

A Gelfand pair $(GL(2n,q), GL(n,q^2))$

ChangHwi Kim (Osaka City University)

I would like to talk about a Gelfand pair $(G(q), H(q))$ in finite reductive groups $G(q)$ and $H(q)$ over a field with q elements. Here, a pair (G, H) is called a Gelfand pair if the permutation representation of G on the coset G/H is multiplicity-free. Following N, Ingliss ph D thesis, we investigate the Gelfand pair (G, H) where G is the $2n$ dimensional general linear group over the field with q elements and H is a subgroup of G which is isomorphic to the n dimensional general linear group over the field with q^2 elements. I would like to talk about my current progress on my master thesis about this Ingliss set up.

Some results on w-SFT-rings

Minjae Kwon (Kyungpook National University)

Let R be an integeral domain with quotient field K. We define a nonzero ideal A of R to be a w-SFT-ideal if there exist a finitely generated ideal $B \subseteq A$ and a positive integer k such that $a^k \in B_w$ for each $a \in A_w$. The ring R is said to be a w-SFT-ring if each nonzero ideal of R is a w-SFT-ideal. Note that an ideal A of R is a w-SFT ideal if and only if A_w is a w-SFT-ideal. In this talk, we study the basic properties of w-SFT-rings. We show that an integral domain R is a Krull domain if and only if R is a completely integrally closed w-SFT-ring.

Examples of application of characteristic classes

Kazuaki Ogiwara (Osaka City University)

Characteristic classes are cohomology classes assigned to given vector bundles.In some cases, vector bundles can be constructed from objects to study. I will talk about some consequences from observation of these characteristic classes.

General Information

• Conference Venue

The conference will be held in Crystal Room and Sapphire Room on the 2nd floor of Hotel Nongshim, Dongnae-gu, Busan, South Korea.

Invited Talks Crystal Room

Student Session Crystal Room and Sapphire Room

Internet Service Free Wi-Fi is available

• Registration

During the conference, the registration desk will be located in front of Crystal Room on the 2nd floor of Hotel Nongshim.

• Hotel Nongshim

Address	23, Geumganggongwon-ro 20beon-gil, Dongnae-gu, Busan, Republic of Korea.
Tel	+82–51–550–2100
Website	http://hotelnongshim.com
Check-in Time	After 02:00PM
Check-out Time	Before 12:00PM
Internet Service	All rooms of the Hotel are equipped with internet connecting jack.

• Presentation

Every talk must use a beam projector. There will be a supplemental board in the lecture room for, e.g., drawing a picture or writing an additional equation. (But don't plan to use this for the whole talk please!) The simplest way would be bringing a pdf using a USB. A laptop connected to the beam projector will be available. We would like to remind that each invited talk is 30 or 45 minutes long, and a student session talk is 15 minutes long. The conference organizers will arrange a volunteer in each lecture room to help speakers to set up their talks.

• Useful Phone Number

Taxi	051–600–1000, 051–200–2000
In emergency	010–3824–6412 (Professor Sang Youl Lee)
	010–6300–1701 (Doctor Jieon Kim)

List of Participants

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Young Ho Im	Pusan National University
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