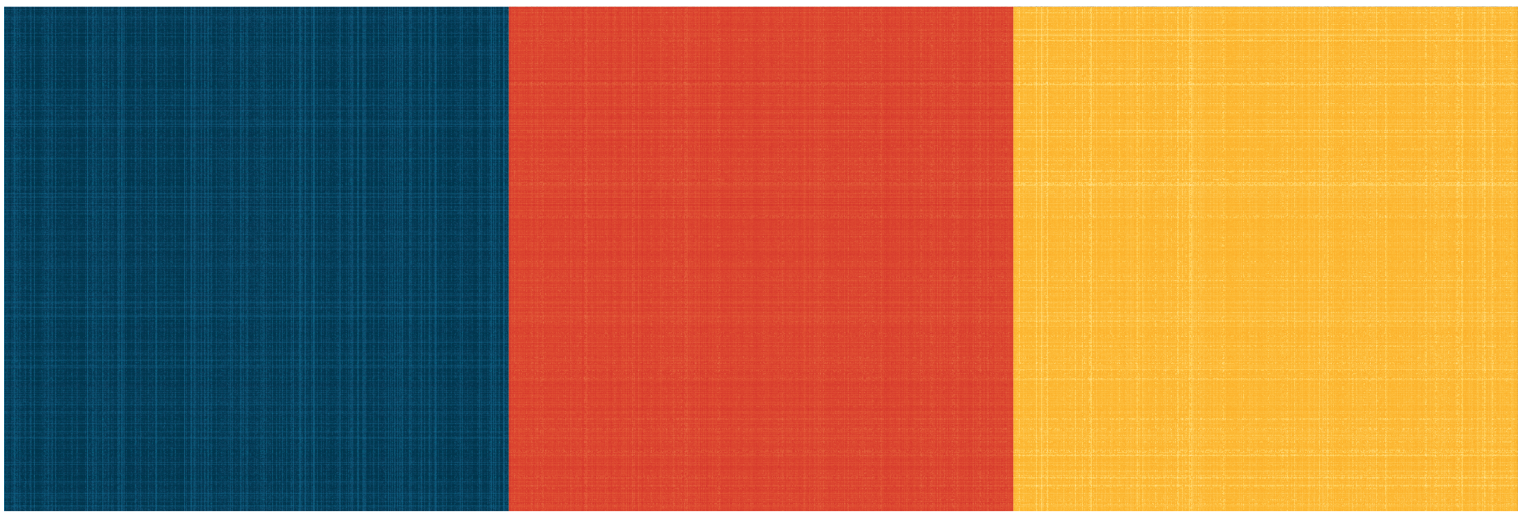
The 5th Conference on

Surfaces, Analysis, and Numerics



Osaka Metropolitan University
January 7-10, 2025

	7 (Tues)	8 (Wed)	9 (Thurs)	10 (Fri)
10:00		**Free Discussion**	**Free Discussion**	**Free Discussion**
10:30		**Sanghun Lee** (Pusan National Univ)	**Yuta Yamauchi** (Yokohama National Univ)	
11:00		**Break**	**Break**	
11:15		**Seungsu Hwang** (Chung-Ang Univ)	**Wai Yeung Lam** (Univ of Luxembourg)	
12:00		**Lunch**	**Lunch**	
14:00	**Registration**	**Tatsuyoshi Hamada** (Nihon Univ)	**Wonjoo Lee** (Korea Univ)	
14:15	**Jin Heo** (Korea Univ)			
14:30			**Break**	
14:45	**Break**	**Break**		
15:00	**Naoya Suda** (Kobe Univ)	**Thomas Raujouan** (Kobe Univ)	**Masaya Hara** (Kobe Univ)	
15:30	**Free Discussion**	**Free Discussion**	**Free Discussion**	
17:00				

Presentation

The 5th Conference on Surfaces, Analysis, and Numerics marks the fifth installment in a series of conferences held between Korea and Japan, focusing on various aspects of differential geometry. Topics covered include, but are not limited to, surface theory, geometric analysis, discrete differential geometry, and numerical analysis.

The goal of this conference series is to bring together both emerging and established mathematicians from around the world, fostering the exchange of ideas and the advancement of research. This year's conference also celebrates the growing partnership between the Department of Mathematics at Korea University and the Osaka Central Advanced Mathematical Institute.

We extend our heartfelt thanks to all the speakers and participants for contributing to the vibrancy and success of this event. We hope you enjoy the conference to its fullest!

Organizing committee

Joseph Cho
Handong Global University

Wayne Rossman
Kobe University

Seong-Deog Yang
Korea University

Masashi Yasumoto
Tokushima University

Tatsuyoshi Hamada
Nihon University

Twenty years of mathematical software

We started our mathematical software project KNOPPIX/Math in 2003. KNOPPIX/Math was the project to archive open source mathematical software and documents in KNOPPIX, which is an operating system designed to be run directly from a CD or DVD. And from 2013, we restarted MathLibre as the direct descendant of KNOPPIX/Math. We're introducing over 100 mathematical software for research and education in these projects. In this talk, I will introduce some topics of recent mathematical software with focus on visualization and presentation.

Seungsu Hwang
Chung-Ang University

Conformal vector fields and its related topics

First we discuss conformal vector fields and its application to Einstein-type manifolds. Also we discuss torse forming vector fields, and then Yamabe soliton in the perspective of conformal vector fields.

Wai Yeung Lam
University of Luxembourg

Discrete hyperbolic Laplacian

The Laplace operator on a Riemannian manifold is a fundamental tool to study the geometry of the manifold. Inspired by electric networks, Laplacians on graphs are defined with edge weights playing the role of conductance. When the edge weights are constant, the graph Laplacian becomes the combinatorial Laplacian and is known to reveal rich combinatorial information of the graph. Given a graph embedded on a surface, it is natural to consider a geometric Laplacian, where edge weights are adapted to the geometry. For the 1-skeleton graph of a geodesic triangulation on a Euclidean surface, there is a "cotangent formula" relating the edge weights to the Euclidean metric. It is known to connect with various problems, e.g. deformations of circle patterns, Delaunay decomposition and discrete harmonic maps. In the talk, we introduce the analogue for hyperbolic surfaces. This is joint work with Ivan Izmestiev.

Masaya Hara
Kobe University

Maximal Darboux transformations

The Darboux transformation is a transformation between isothermic surfaces and known for offering interesting examples, such as transforming a cylinder into a bubbleton. In this talk, we focus on maximal surfaces, which have identically zero mean curvature in Minkowski space. Based on a geometric definition, we construct their Darboux transformations and investigate their properties. This talk is based on joint work with J. Cho, A. Honda, T. Raujouan and W. Rossman.

Jin Heo
Korea University

Reptile trapezoids and the characterization of convex reptiles

A reptile is a geometric figure that can be dissected into $k \geq 2$ pairwise congruent pieces, each similar to the original figure. Convex reptile polygons are known to be either triangles or trapezoids, while non-convex reptile n-gons exist for all even $n \geq 6$. However, the complete characterization of reptile trapezoids remains open. In recent collaborative work with Miklós Laczkovich, we established some necessary conditions for a trapezoid to be a reptile. Notably, we proved that the sides of a reptile trapezoid that is not a parallelogram and not a right trapezoid of particular type must be pairwise commensurable. As a result, we demonstrated that the number of non-similar reptile trapezoids that are not parallelograms is at most countable. Additionally, in my independent research, documented in a preprint, I investigated some properties of right trapezoid reptiles and discovered a new fifth example of a reptile trapezoid that is not a parallelogram.

Sanghun Lee
Pusan National University

Stable capillary hypersurfaces and rigidity in Riemannian manifolds

In this talk, we investigate rigidity phenomena for stable capillary hypersurfaces embedded in Riemannian manifolds, focusing on their relationship with scalar curvature. We begin by discussing rigidity in 3-dimensional Riemannian manifolds. Next, we explore topological and geometric invariants in higher dimensions, delving into the rigidity of high-dimensional Riemannian manifolds. Finally, we examine the interplay between positive scalar curvature in high-dimensional Riemannian manifolds and topological invariants of stable capillary hypersurfaces. This is joint work with Sangwoo Park and Juncheol Pyo.

Wonjoo Lee
Korea University

Ruled minimal surfaces in the three-dimensional light cone

Ruled minimal surfaces are classified in various three-dimensional spaces. In this talk, we present our classification of all ruled minimal surfaces in the three-dimensional lightcone using the Hermitian model

$$\mathbb{Q}^3_+ := \{X \in \mathrm{Herm}(2,\mathbb{C}) : \det X = 0, \mathrm{tr}\, X > 0\},$$

and origin fixing isometry of $\mathbb{L}^4$.

Thomas Raujouan
Kobe University

A numerical algorithm for Iwasawa decomposition

The theory of constant mean curvature (CMC) surfaces greatly benefits from computer graphics. While drawing a minimal surface is relatively straightforward thanks to the Weierstrass representation, using the DPW method to draw a non-minimal CMC surface requires to compute an algebraic splitting in an infinite-dimensional Lie group known as the Iwasawa decomposition. We will present an algorithm that computes an approximation of the Iwasawa decomposition and give an explicit example where the algorithm produces the exact solution.

Naoya Suda
Kobe University

Explicit Lax representation for discrete circular nets of revolution with constant negative Gaussian curvature

First, we give the explicit parametrizations of circular nets with constant negative Gaussian curvature (we abbreviate this to cK-nets) and rotational symmetry. Next, we introduce the Lax representation and Bäcklund transform for cK-nets, which are constructed by T. Hoffmann and A. O. Sageman-Furnas. Then, using them, we examine Lax representations with rotational symmetry, which correspond to explicit parametrizations of cK-nets of revolution. Solving for the Lax representation, we give the associated family of cK-nets of revolution. Moreover, we will consider the resonance points for the Bäcklund transforms of cK-nets of revolution and show resulting graphics.

Yuta Yamauchi
Yokohama National University

The total absolute curvature of submanifolds with singularities

For an n-dimensional immersed compact submanifold in Euclidean space $\mathbb{R}^{n+r}$, it is known that the total absolute curvature is greater than or equal to the sum of the Betti numbers. Moreover, the total absolute curvature is equal to 2 if and only if the submanifold is a convex hypersurface embedded in an affine $(n+1)$-subspace of $\mathbb{R}^{n+r}$ (the Chern-Lashof theorem). In this talk, we show a Chern-Lashof type theorem for submanifolds with singularities in Euclidean space. More precisely, we prove that for an n-dimensional admissible compact frontal in $\mathbb{R}^{n+r}$, its total absolute curvature is greater than or equal to the sum of the Betti numbers. Furthermore, if the total absolute curvature is equal to 2 and all singularities are of the first kind, then the image of the frontal coincides with a closed convex domain of an affine n-subspace of $\mathbb{R}^{n+r}$.