GEOMETRIC MODELLING SEMINAR

12th & 13th June 2023
Conference Room
School of Mathematical Sciences

MEET THE SPEAKERS

Prof. Kenjiro T. Miura
SHIZUOKA UNIVERSITY

Assoc. Prof. Tadatoshi Sekine
SHIZUOKA UNIVERSITY

Assoc. Prof. Peter Salvi
BUDAPEST UNIVERSITY OF TECHNOLOGY AND ECONOMICS

Assoc. Prof. R.U. Gobithaasan
UNIVERSITY MALAYSIA TERENGGANU

Register for free now!

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SCHEDULE

12th June 2023

Time	Programme
9.00 am	A Motion Planner for Differential Drive Mobile Robots on Circular and Spiral Arc Trajectories *Wan Zafira Ezza Wan Zakaria* *Universiti Sains Malaysia*
10.00 am	Welcoming remarks by the Dean of the School of Mathematical Sciences
10.30 am	Aesthetic Curve and Cute Curve *Prof. Dr. Kenjiro T. Miura* *Shizuoka University, Japan*
12.00 pm	Generalized Fractional Bézier Curve and Surface with Application *Syed Ahmad Aidil Adha Said Mad Zain* *Universiti Sains Malaysia*
1.00 pm	Lunch Break
2.30 pm	Genuine Multi-Sided Surfaces in CAGD *Assoc. Prof. Dr. Peter Salvi* *Budapest University of Technology and Economics, Hungary*
4.00 pm	End of Day 1

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SCHEDULE

13th June 2023

Time	Programme
9.30 am	Harnessing Shape Quantification for Enhanced Data Analytics *Assoc. Prof. Dr. Gobithaasan Rudrusamy* *Universiti Malaysia Terengganu, Malaysia*
11.00 am	Coffee Break
11.30 am	Isogeometric Analysis using C^2 interpolating Splines *Assoc. Prof. Dr. Tadatoshi Sekine* *Shizuoka University, Japan*
1.00 pm	Lunch End of Day 2

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Prof. Kenjiro T. Miura

SHIZUOKA UNIVERSITY

AESTHETIC CURVE AND CUTE CURVE

We explain kappa-curve as well as the log-aesthetic curve. The kappa-curve is an interpolating spline which is curvature-continuous almost everywhere and passes through input points at the local curvature extrema. It has been implemented as the curvature tool in Adobe Illustrator and Photoshop and is accepted as a favored curve design tool by many designers. We also discuss its extension for local control of curvature extrema.

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Assoc. Prof. Tadatoshi Sekine

SHIZUOKA UNIVERSITY

ISOGEOMETRIC ANALYSIS USING C^2 INTERPOLATING SPLINES

In this talk, we introduce a method to accurately incorporate the inhomogeneous boundary condition (IBC) by combining the IGA and C^2 interpolating splines. Curves and surfaces using NURBS and B-splines have the property that they do not always pass through given control points. In isogeometric analysis (IGA), on the other hand, known values can be applied to only control variables defined on the control points. Therefore, it is not easy to give a specific value as a boundary condition at a certain location on a surface, since the location of the surface and the control point are different. A boundary condition that gives a non-zero value at a certain location is called the IBC, and how to incorporate the IBC in the IGA formulation is one of the main problems in the IGA community. Since the C^2 interpolating splines always pass through control points, it is expected that the non-zero values can be easily given on desired points by placing control points at positions where the IBC is defined.

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Assoc. Prof. Peter Salvi

BUDAPEST UNIVERSITY OF TECHNOLOGY AND ECONOMICS

GENUINE MULTI-SIDED SURFACES IN CAGD

The geometric design of free-form surfaces - ranging from simple household objects to car bodies - involves the use of feature curves to divide the model into natural regions, some of which are non-quadrilateral. These irregular areas are usually represented in CAD systems either by a larger quadrilateral with trimmed boundaries, or by an artificial subdivision into smaller four-sided patches.

In this talk, we are going to look at various approaches to express these surfaces in a genuinely multi-sided (and hence non-standard) form, and discuss the advantages and drawbacks of the various methodologies. Topics include transfinite interpolation surfaces, implicit patches, control-point-based representations, handling concave and multi-connected configurations, and exporting into CAD-compatible formats.

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UNIVERSITY MALAYSIA TERENGGANU

HARNESSING SHAPE QUANTIFICATION FOR ENHANCED DATA ANALYTICS

In an era of unprecedented data generation, the ability to extract meaningful insights from complex datasets is crucial. Traditional data analysis methods often overlook the inherent structural information present in data, limiting the depth and accuracy of the insights obtained. Shape quantification focuses on capturing and analysing the topological and geometrical properties, and relationships within data objects. This presentation delves into a cutting-edge shape quantification technique known as Topological Data Analysis (TDA).TDA is a recently developed approach that leverages the principles of Algebraic Topology to measure the structure of high-dimensional datasets. It encompasses two distinct methodologies: Persistent Homology (PH) and the Mapper algorithm. The presentation explores the extraction of meaningful shape-based information using TDA and showcases its potential to enhance data classification, clustering, and visualization. By applying TDA, researchers, practitioners, and data scientists can gain deeper insights into complex datasets, uncover hidden patterns, and make more informed decisions. The primary objective of this presentation is to inspire the audience to incorporate shape quantification techniques, specifically TDA, into their data analytics workflows. By embracing TDA, data analysts can unlock the full potential of shape-based information, leading to more comprehensive and meaningful results in various domains.

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Postgraduate Student Presentation

A MOTION PLANNER FOR DIFFERENTIAL DRIVE MOBILE ROBOTS ON CIRCULAR AND SPIRAL ARC TRAJECTORIES

Wan Zafira Ezza Wan Zakaria

Abstract: Mobile robots play a vital role as dynamic systems in various modern applications. The ability to securely and inexpensively move from one location to another is made possible by motion planning, which is a critical task for these robots. Extensive research has been conducted on motion planning in the context of sensor applications. However, without the sensor data, research is constrained since it is challenging to continuously re-plan the robot's movements to ensure it follows the route that need to be executed. Our research primarily concentrates on sensorless motion planning, leveraging the computational techniques of curves within the field of Computer-Aided Geometric Design (CAGD). Considering that both the initial point, end point, and the initial direction are known, this study describes the circular arc and clothoid-based with sensorless motion planning algorithm for differential drive mobile robot movement. Due to their reliability and ease of use, differential drive mobile robots are widely used in a variety of vehicles and robots. A mobile robot equipped with a differential drive system utilizes the distribution of speed between its left and right wheels to enable movement. The robot's wheels' left and right speeds are determined by the curvature value. In the case of a circular arc, we present the process of obtaining the arc, connecting it between three points, and its simulation result. Similarly we show a specific approach used for clothoid trajectories. In both cases, the curve formulation and computation is adapted for the purpose of this problem. All points will be interpolated with G^I continuity. The technique is created utilizing Matlab's Remote API capabilities and CoppeliaSim's robot simulation software. By comparing clothoid trajectories and circular arc trajectories, we have observed that the robot can be moved more accurately using clothoid trajectory.

Postgraduate Student Presentation

GENERALIZED FRACTIONAL BÉZIER CURVE AND SURFACE WITH APPLICATION

Syed Ahmad Aidil Adha Said Mad Zain

Abstract: The construction of new aesthetic Bézier curve and surface is an emerging topic in Computer Aided Geometric Design (CAGD). The aesthetic Bézier curve and surface have more flexibility since it can change shape without altering the control points via shape parameters. This study proposed a new aesthetic Bézier curve and surface known as generalized fractional Bézier curve and surface. Using the Riemann-Liouville fractional integral definition, the generalized fractional Bézier curve and surface have two types of parameters: shape and fractional. Fractional parameters can be utilized to control the optimal length and size of the curve and surface. A new kind of continuity known as fractional continuity is developed using fractional parameters. The fractional continuity can be used in the curve fitting process and make the process more intuitive. A new method known as the "cut and combine" is proposed in the curve fitting process to remove unwanted high curvature profile curve. In connecting consecutive surfaces, fractional continuity enables the second surface to be connected at any arbitrary line of the first surface. Thus, it simplifies the subdivision method and continuity in one simple process by changing the fractional parameters. Hence, the generalized fractional Bézier curve and surface is an excellent tool for modelling complex curves and surfaces.