

# Lei Wang

HE/HIS/HIM

Qingdao, China

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“The unknown is not a limit, but a silent invitation.”

## Education

### Shandong University

M.ENG IN COMPUTER TECHNOLOGY

Shandong, China

Sep. 2022 - now

- **GPA:** 3.54/4.0 (**Score of Computer Graphics:** 99/100)
- **Advisor:** Prof. Shiqing Xin
- **Research Interests:** Computer Graphics and Geometry Processing

### Harbin University of Science and Technology

B.ENG IN SOFTWARE ENGINEERING

Heilongjiang, China

Sep. 2018 - Jun. 2022

- **GPA:** 3.94/4.5 | **Rank:** 2/309 (1%)
- **Research Interests:** Data Mining and Recommendation Systems
- **Thesis:** Fashion Recommendation System Based on Data Augmentation (**Outstanding Award**)
- **Outstanding Graduate**

## Publication

### PCO: Precision-Controllable Offset Surfaces with Sharp Features [Project Page]

SIGGRAPH ASIA'24 (Journal Track)

LEI WANG, XUDONG WANG, PENGFEI WANG, SHUANGMIN CHEN, SHIQING XIN, JIONG GUO, WENPING WANG, CHANGHE TU

Accepted

#### Brief Description:

- Proposed an accurate computation of the offset surface while preserving sharp features by leveraging the fact that smoothness of triangle-based distance fields except at the triangles themselves.
- Present a discrete implementation that begins with tetrahedralizing the space and slicing each tetrahedron with a set of planes. The size of the tetrahedra can be adjusted to control the precision of the approximation.
- Addressed complexity simplification of the offset surface through a maximal-clique formulation, ensuring sharp feature retention.
- Extended to support additionally morphological operations, such as opening and closing.

#### MY Contributions:

- This project was executed independently under the supervision of my advisor Shiqing Xin.
- Implemented all the code for the project and designed all experiments associated with the research study.
- Authored the manuscript and produced all visual content for the publication.
- Created a fast-forward video and conducted the presentation delivery.

### Mesh Slicing Along Isolines of Surface-Based Functions [Paper]

Pacific Graphics'24 (Conference)

LEI WANG, XUDONG WANG, WENSONG WANG, SHUANGMIN CHEN, SHIQING XIN, CHANGHE TU, WENPING WANG

Accepted

#### Brief Description:

- Proposed a methodology for precise tracing of the isolines of a function defined on a surface. This method fundamentally separates the approximation of the surface-based function from the piecewise linear representation of the geometry.
- Recast the challenge of isoline extraction into a solvable power diagram problem, with the weights established by the first-order approximation of given function.
- Designed a novel feature-preserving fine-tuning framework with the potential to be integrated into other isoline extraction methods.
- Implemented our algorithm in a range of applications, notably in contouring specific field.

#### MY Contributions:

- Developed the underlying algorithms.
- Wrote the entire codebase for the project.
- Engineered all research experiments pertinent to the study.
- Composed the academic paper.
- Presented the findings at the conference.

## ITS: Implicit Thin Shell for Polygonal Meshes [\[Paper\]](#) [\[Code\]](#) [\[Video\]](#)

IEEE TVCG

HUIBIAO WEN, **LEI WANG**, YUNXIAO ZHANG, SHUANGMIN CHEN, SHIQING XIN, CHONGYANG DENG, CHANGHE TU, YING HE,  
WENPING WANG

Under Review

### Brief Description:

- Introduced a novel representation of the sandwich-walled space of an input surface, in which the implicit function is expressed as a tri-variate tensor-product B-spline.
- Transformed the challenge of finding extreme function values across infinite points into identifying extremes within a finite set of candidates, ensuring rigorous wrapping of the input surface.
- Proposed a series of acceleration strategies to optimize runtime performance, achieving substantial speedups in inside-outside tests.
- Adapted the method to the established QEM technique for mesh simplification, enabling precise global error control.

### MY Contributions:

- Proposed the SVO module featured in the algorithm.
- Implemented all code on both GPU and CPU platforms, and designed the experiments.
- Contributed to the refinement of the manuscript.
- Produced a video for this paper.

## Towards Voronoi Diagrams of Surface Patches [\[Paper\]](#) [\[Code\]](#)

IEEE TVCG

PENGFEI WANG, JIANTAO SONG, **LEI WANG**, SHIQING XIN, DONGMING YAN, SHUANGMIN CHEN, CHANGHE TU, WENPING WANG

Under Review

### Brief Description:

- Proposed a novel method that compute the Voronoi diagram of a collection of surface patches, addressing a challenging task in past research.
- The fundamental operations are elevated from 3D to 4D, enabling the computation of the extended Voronoi diagram, confined within a tetrahedron, through a sequence of 4D hyperplane cutting.
- Apply the algorithm to compute medial-axis surfaces and demonstrate its superior performance.

### MY Contributions:

- Assisted in refining the manuscript and contributed to the design of experiments.

## Research Projects

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### Generating Offset Curves of Single-board PCB

**COLLABORATOR:** [HUAWEI TECHNOLOGIES Co., LTD.](#)

Feb. 2024 - now

- This project focuses on computing offset results for PCB data consisting of numerous 2D segments and arcs.
- Designed a 2D BVH for line segments and arcs, achieving fast closest-point queries and real-time collision detection. [\[Code\]](#) [\[Video\]](#)
- Developed a robust algorithm for offset computation using a multi-piecewise linear distance field approximation.
- Created an efficient algorithm based on power diagrams to compute offset results while preserving sharp features.
- Compared to traditional methods, our approaches are straightforward to implement, guarantee correct topology, and are free of self-intersections.

### Explicit Surface Reconstruction

**ADVISOR:** [PROF. SHIQING XIN](#); [POSTDOC CHEN ZONG](#)

Nov. 2022 - Mar. 2023

- The theme of this project is to study how to extract a high-quality triangle mesh from a geometric domain equipped with the point-to-surface projection operation.
- Proposed a fast and effective strategy to eliminate geometric/topological ambiguities as far as possible.
- Developed an enhanced GradNormal algorithm for extracting an accurate mesh from volume data.
- One paper titled *A Region-growing GradNormal Algorithm for Geometrically and Topologically Accurate Mesh Extraction* is accepted to SPM 2023 and honored the **1st Best Paper Award**. [\[Paper\]](#)

### GeoToolKit [\[Code\]](#)

**SELF-DEVELOPED PROJECT**

Continuously developed since Jan. 2024

- This C++ library integrates major geometric libraries like CGAL, geogram, and libIGL to provide advanced geometric functionalities including half-edge data structures, Voronoi diagrams, power diagrams, Apollonius diagrams, and visualization tools.
- Designed the toolkit to support both advanced research and educational use, facilitating easier understanding and implementation of complex geometric algorithms for students and researchers.
- This project is continuously expanding its capabilities, adding features such as geodesics computation, implicit surface reconstruction, surface parameterization, mesh repair, discrete differential geometry operators, and remeshing techniques to keep pace with the latest developments in geometric processing.

## Particle System [Code]

SELF-DEVELOPED PROJECT

Nov. 2023

- This project implemented the strategies outlined in the paper *Particle-Based Anisotropic Surface Meshing*, focusing on both isotropic and anisotropic meshing techniques.
- The implementation enhanced mesh quality and optimized geometric detail retention, particularly beneficial for complex simulations in engineering and animation.

## GPU Based Sparse Voxel Octree [Code]

SELF-DEVELOPED PROJECT

Mar. 2023

- Sparse Voxel Octree (SVO) is a hierarchical data structure that efficiently represents 3D space by subdividing it into a tree of voxels, allowing for optimized storage and quick access in applications like 3D rendering and collision detection.
- Implemented this volumetric data structure in CUDA, enabling efficient construction and managing geometric primitives (vertices, edges, and faces) through a linear Morton code representation.
- This project was utilized in the paper *ITS: Implicit Thin Shell for Polygonal Meshes*.

## GPU Marching Cubes [Code]

SELF-DEVELOPED PROJECT

Dec. 2022

- Marching Cubes (MC) is an algorithm used to extract a polygonal mesh of an isosurface from 3D volumetric data, widely applied in medical imaging and scientific visualization.
- Implemented this algorithm in CUDA, achieving several-fold speedup over the CPU-based approach.

## Parallel Pixelization for Geographic Data [Code]

ADVISOR: ASSISTANT PROF. DEJUN TENG

Sep. 2022

- This project utilized OpenGL as the visualization frontend, with pThread, OpenMP and CUDA as acceleration backends.
- Developed a visualization system for efficiently pixelizing geographic data on both CPU and GPU platforms in parallel.

# Internships

## CADsoft: Advanced Curve and Surface Design and Intersection Software

AMSS, CAS

DEVELOPMENT INTERN

Summer 2023

- Contributed to a CAD system development project, supporting core functionalities and system architecture.
- Integrated various geometric algorithms into the system, including Voronoi tessellation, surface reconstruction, and geodesic computation.
- Developed the system's user interface using ImGui and Qt.

# Academic Experience

## SIGGRAPH Conference and Exhibition on Computer Graphics and Interactive Techniques in Asia

Tokyo, Japan

PRESENTER

Dec. 2024

- Presented my paper *PCO: Precision-Controllable Offset Surfaces with Sharp Features*, discussing the development of the method for generating offset surfaces that maintain sharp features with controllable precision.

## Pacific Conference on Computer Graphics and Applications

Huangshan, China

PRESENTER

Oct. 2024

- Presented my paper *Mesh Slicing Along Isolines of Surface-Based Functions*, covering the methodology and applications of isoline-based slicing techniques for enhanced surface analysis and processing.

## Summer Seminar

IRC, Shandong University

PARTICIPANT & PRESENTER

Jul. 2023 (2024) - Aug 2023 (2024)

- Participated in discussions and presented recent advanced research topics. e.g., *Monte Carlo Geometry Processing*, *Numerical Optimization in Geometry Processing*, *Introduction to Differential Geometry*, *Shape Deformation*, *Continuous Collision Detection*, *Finite Element Method*.

## Summer School

IRC, Shandong University

PARTICIPANT & VOLUNTEER

Jul. 2023 (2024)

- Assisted with hands-on DIY projects such as robotic path planning and geometric modeling.
- Supported event photography and contributed to writing press releases.

International Conference on Geometric Modeling and Processing

Qingdao, China

PARTICIPANT AND VOLUNTEER

Jun. 2024

- Explored emerging trends and solutions in geometric modeling, simulation, and computing, with applications spanning computer graphics, engineering, and scientific computing.
- Assisted in organizing and managing conference activities, including participant registration, session coordination, and logistical support, enhancing the overall attendee experience and fostering smooth event operations.

China Intelligent Robotics Annual Conference

Qingdao, China

PARTICIPANT

Aug. 2023

- Attended sessions on the latest advancements in intelligent robotics, including applications in AI-driven automation and control.

The CCF Advanced Disciplines Lectures - Embodied Intelligence

Tsinghua University

PARTICIPANT

Jun. 2023

- Gained insights into the architecture, technologies, challenges, and applications of embodied intelligence in fields like navigation and robotic manipulation.

Teaching

Feb - Jul  
2024

Teaching Assistant, Advanced Programming Language Design (C++)

Shandong  
University

Selected Honors & Awards

2024	Candidate for the President's Award, Shandong University (0.25%)	Shandong, China
2024	National Scholarship, Shandong University (1%)	Shandong, China
2023	Graduate Student of the Year Award, Shandong University (50%)	Shandong, China
2022	Outstanding Graduate, Harbin University of Science and Technology (1%)	Harbin, China
2021	Merit Student, Harbin University of Science and Technology (5%)	Harbin, China
2021	2nd Prize, China Undergraduate Mathematical Contest in Modelling	Harbin, China
2021	2nd Prize, Mathorcup University Mathematical Modeling Challenge	Harbin, China

Skills & Interests

Languages:

- Mandarin (native)
- English (TOEFL iBT: 89/120)

Programming Languages:

- Expert: C/C++, CUDA, Python.
- Advanced: Java, Javascript, HTML, GLSL.
- Intermediate: MATLAB.

Frameworks:

- Expert: OpenMP, CGAL, libIGL, geogram, OpenMesh.
- Advanced: ImGui, OpenGL, PyTorch, Jupyter Notebook.
- Intermediate: TBB, Qt, Django, NodeJS, Vue, Spring.

Software/Tools:

- Expert: Git, CMake, 微信, Linux, Nsight System, Nsight Compute, Docker, Visual Studio, VS Code, CLion, PyCharm, IDEA.
- Advanced: Blender, Adobe Premiere, Adobe Premiere.
- Intermediate: 3ds Max, Adobe Illustrator, Adobe Photoshop.

Interests:

- Basketball, Swimming, Skating, Musical, Art.