Xingyi **Du**

du.xingyi@wustl.edu | duxingyi-charles.github.io | duxingyi-charles

Education

Washington University in St. Louis — *St. Louis, USA*

Ph.D. Candidate in Computer Science — *Aug. 2018 - present*

- Advisor: Prof. Tao Ju · Graphics and geometry processing
- GPA: 4.0/4.0

Tsinghua University — *Beijing, China*

M.E. in Software Engineering — *Aug. 2015 - Jun. 2018*

- Advisor: Prof. Hui Zhang & Prof. Dong-Ming Yan · Triangle and quad remeshing
- GPA: 3.7/4.0, Rank: 1/131, Graduate with Honors

Tsinghua University — *Beijing, China*

B.E. in Material Science and Engineering (Physics branch) — *Aug. 2011 - Jun. 2015*

- GPA: 91/100
- Minor in Computer Science

Research Interests

Computer graphics, Geometry processing, Geometric modeling, Optimization, Deep learning

Publications

Isometric Energies for Recovering Injectivity in Constrained Mapping

Xingyi Du, Danny M. Kaufman, Qingnan Zhou, Shahar Z. Kovalsky, Yajie Yan, Noam Aigerman, Tao Ju

SIGGRAPH Conference Proceedings (Proc. SIGGRAPH Asia 2022)

Robust Computation of Implicit Surface Networks for Piecewise Linear Functions

Xingyi Du, Qingnan Zhou, Nathan Carr, Tao Ju

ACM Transactions on Graphics (Proc. SIGGRAPH 2022)

Optimizing Global Injectivity for Constrained Parameterization

Xingyi Du, Danny M. Kaufman, Qingnan Zhou, Shahar Z. Kovalsky, Yajie Yan, Noam Aigerman, Tao Ju

ACM Transactions on Graphics (Proc. SIGGRAPH Asia 2021)

Boundary-Sampled Halfspaces: A New Representation for Constructive Solid Modeling

Xingyi Du, Qingnan Zhou, Nathan Carr, Tao Ju

ACM Transactions on Graphics (Proc. SIGGRAPH 2021)

Lifting Simplices to Find Injectivity

Xingyi Du, Noam Aigerman, Qingnan Zhou, Shahar Kovalsky, Yajie Yan, Danny M. Kaufman, Tao Ju

ACM Transactions on Graphics (Proc. SIGGRAPH 2020)

Field-Aligned Isotropic Surface Remeshing

Xingyi Du, Xiaohan Liu, Dong-Ming Yan, Caigui Jiang, Juntao Ye, Hui Zhang

Computer Graphics Forum (Proc. Eurographics 2018)

Quad Mesh Generation via Field-Aligned Centroidal Voronoi Tessellation

Xingyi Du, Dong-Ming Yan, Juntao Ye, Hui Zhang

China CAD&CG (Proc. China CAD&CG 2017)

Research Projects

Implicit Shape Modeling

Collaboration: WashU, Adobe Research *2020 - ongoing*

- Beyond a single implicit function (e.g., SDF), multi-function implicit representations better capture sharp features, surface segmentations, and spatial decompositions, thus facilitating higher-level shape understanding and editing. We proposed a novel representation for solid shapes with piecewise smooth surfaces (e.g., mechanical parts, architectures). Compared to the traditional Constructive Solid Geometry (CSG), our representation is intuitive to understand and edit. It also simplifies the reverse engineering process (3D reconstruction from meshes or point clouds).
- Shape modeling using multiple implicit functions often needs to extract the mesh of a network of implicit surfaces. We proposed a unified approach to meshing two common types of implicit surface networks (implicit arrangement and material interfaces). Leveraging a novel robust predicate, our approach guarantees the correct combinatorial structure of the surface network and is orders of magnitude faster than existing methods.
- Paper "Boundary-Sampled Halfspaces: A New Representation for Constructive Solid Modeling" is accepted to Siggraph 2021.
- Paper "Robust Computation of Implicit Surface Networks for Piecewise Linear Functions" is accepted to Siggraph 2022.

Injective Mapping under Constraints

Collaboration: WashU, Adobe Research, Meta Reality Labs *2018 - ongoing*

- Many graphics applications (e.g., texture mapping, deformation, simulation) require one-to-one (injective) mapping of a mesh to another domain, possibly under positional constraints, such as a prescribed boundary or handles. We proposed novel energies that measure the non-injectivity of a mapping. The energies are simple to optimize, and their global minima have provable injectivity guarantees. Optimizing our energies produces injective mappings with a high success rate while satisfying positional constraints.
- Developed quasi-Newton and projected-Newton solvers for efficient optimization of our energies.
- Constructed two benchmark datasets (each containing thousands of meshes) for evaluating state-of-art injective mapping methods.
- Generalized the energies to produce injective mappings with low isometric distortion.
- Paper "Lifting Simplices to find Injectivity" is accepted to Siggraph 2020.
- Paper "Optimizing Global Injectivity for Constrained Parameterization" is accepted to Siggraph Asia 2021.
- Paper "Isometric Energies for Recovering Injectivity in Constrained Mapping" is accepted to Siggraph Asia 2022 (conference track).

High Quality Surface Remeshing

Collaboration: Tsinghua University, Chinese Academy of Sciences *2016 - 2018*

- Generating high-quality meshes or improving the quality of existing ones is crucial for many applications. We proposed a new approach for triangular remeshing by aligning mesh edges to a directional field. The resulting mesh has better angle quality and fewer singularity artifacts. We also generalized the approach to generate quad-dominant meshes.
- Paper "Quad Mesh Generation via Field-Aligned Centroidal Voronoi Tessellation" is accepted to China CAD&CG 2017.
- Paper "Field-Aligned Isotropic Surface Remeshing" is accepted to Eurographics 2018.

Work Experience

Shape Modeling using Implicit Representations *Adobe Research*

Research Intern *Summer 2021, 2022*

- Developed an interactive 3D modeling software based on our novel solid shape representation, which allows users to create 3D solid shapes from a sparse set of points.
- Developed a robust and efficient algorithm for meshing the network of multiple implicit surfaces, such as arrangements and material interfaces.
- Surveyed the literature on implicit representations.

Morphable Human Face Reconstruction from RGB-D Images *MEGVII (Face++) Research*

Research Intern *Summer 2017*

- Developed a pipeline to reconstruct 3D models from RGB-D photos of human faces. The pipeline includes rigid registration based on Iterative Closest Point and non-rigid registration by fitting a morphable face model to point clouds. The fitting considers reconstruction error, landmark correspondence, silhouette matching, and shape regularity.

Activities

Academic

2022 **Reviewer,** Siggraph
2020 **Reviewer,** Computers & Graphics
2020 **Reviewer,** SPM (Solid and Physical Modeling)

Teaching

2020 **TA,** CSE554: Geometric Computing for Bio-medicine *WashU*
2019 **TA,** CSE546: Computational Geometry *WashU*
2016 **TA,** Digital Media I: Graphics and Animation *Tsinghua*

Talk

2022 **Institute of Automation, Chinese Academy of Sciences**, 3D shape modeling and geometric computing based on multi-function implicit representations

2022 **Dynamic Graphics Project Lab, University of Toronto**, Shape Modeling using multiple implicit functions

Skills

Programming C++, Python, Mathematica
Math Linear Algebra, Real/Complex Analysis, Statistics, Topology, Measure Theory, Functional Analysis
Languages Chinese, English