Yunting Song

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University of Maryland

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Education

University of Maryland (UMD), College Park, MD, USA — Aug. 2018 - Dec. 2023 (Expected)
PhD student in Geospatial Information Science — GPA: 4/4
Dissertation title: Efficient Terrain Analysis of Point Cloud Datasets on a Decomposition-Based Data Representation

Wuhan University (WHU), Wuhan, China — Sep. 2014 - Jun. 2018
B.S. in Remote Sensing Science and Technology — GPA: 3.75/4

Research Interests

Terrain mesh analysis and processing, Spatial data structures and algorithms, Computational geometry, Parallel computing

Research Experience

Research Member / Terrain trees Project page — **Aug. 2018 — Present**
GeoVis lab, UMD — *Maryland, USA*
Research project with my advisor Prof. Leila De Floriani, Dr. Riccardo Fellegara, and Dr. Federico Iuricich

- The goal of this project is to develop an efficient data representation for triangle meshes and to design distributed terrain analysis algorithms on this new data structure
- Contributed to the development of a new hierarchical data representation called Terrain trees, which relies on a **sequential run-length encoding** and different **decomposition-based spatial indexes**
- Contributed to the development of the Terrain Trees Library using **C++** and optimized the time and memory performance of several modules and core mesh connectivity relation queries
- Designed and implemented algorithms for extracting terrain features, such as slope, curvature, and roughness on triangle meshes generated from **LiDAR** point cloud data
- Designed and implemented algorithms for computing a multifield measure using **Eigen** library, which facilitates the visual analysis of the alignment extent of the pattern of multiple fields
- Implemented the algorithm for computing the terrain topology on large triangle meshes containing **200 million** vertices
- Designed and conducted experiments for performance evaluation of Terrain trees, including the analysis and comparison with the most compact data structure to date
- Collaborated with another PhD student on building **python wrappers** for the developed C++ libraries via **Cython**

Research Member / Efficient triangle mesh processing Project page — **Feb. 2019 — Present**
GeoVis lab, UMD — *Maryland, USA*

- Implemented a topological cancellation algorithm, which involves **mesh traversal** and **data structure update**, for removing noise from terrain meshes generated from LiDAR point cloud
- Designed a new topology-aware simplification algorithm, which can reduce the size of a triangle mesh while maintaining critical features on terrain surface
- Designed and implemented a new algorithm for **parallel** triangle mesh simplification on Terrain trees using **OpenMP**
- Wrote and published an ACM SIGSPATIAL research paper in 2021
- Developed a Delaunay triangulation program on a **Point-Region (PR)-quadtree**

Project Leader / Spatio-temporal analysis on Tianjin Eco-city — **Feb. 2017 — Jun. 2018**
Chinese Academy of Sciences — *Beijing, China*
Undergraduate research project with Prof. Ling Peng on developing analytical models of urban development for Tianjin Eco-city

- Evaluated the development status of Tianjin Eco-city from aspects including environment, resources, public transport, and urban component management
- Made comparative analysis of various algorithms
- Established models for evaluating the service level of bus lines within the study area and to propose improvements

Research Member / GeoCommerce — **Apr. 2016 — Jun. 2018**
Professor Huayi Wu's Lab, WHU — *Hubei, China*
Research project with Prof. Zhipeng Gui on developing GeoCommerce Visualization Analysis System

- Developed a search page on the database of Web Map Service (WMS) resources via **REACT** library and **RESTful** APIs via **Java**
- Implemented algorithms calculating gravity trajectory and standard deviational ellipse (SDE) on an **Apache Spark** cluster
- Utilized **Spark-jobserver** library to supply RESTful Spark web services
- Built a webpage for visualizing the results of gravity trajectory and SDEs via **JavaScript** libraries including **jQuery.js** and **D3.js**

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Research Member / Undergraduate student research program **Sept. 2015 — Mar. 2018**
WHU *Hubei, China*
Research project with Dr. Zhipeng Gui at Wuhan University on China regional economic development based on Geographical and Temporal Weighted Regression

- Analyzed **16 million** records of registration data of all enterprises in China from 1960 to 2015 via **MySQL** and **R**
- Made research plan and collaborated with four members
- Made visualization of analytic results via **JavaScript** and **echarts** library
- Concluded the influence on GRP of different Chinese regions from time, location and other factors

Publications

- **Yunting Song**, Riccardo Fellegara, Federico Iuricich, Leila De Floriani, "**Efficient topology-aware simplification of large triangulated terrains**", Proceedings of ACM SIGSPATIAL, Beijing, China, 2021, 576–587. (Acceptance rate: 22.4%).
- Riccardo Fellegara, Federico Iuricich, **Yunting Song**, Leila De Floriani, "**Terrain trees: a framework for representing, analyzing and visualizing triangulated terrains**", Geoinformatica, 2021 (Accepted under minor revision).
- Shuhan Lou, Ling Peng, **Yunting Song**, Xuantong Chen, Chengzeng You, "**Optimization of Bus Service with a Spatio-Temporal Transport Pulsation Model**", Proceedings of Future of Information and Communications Conference (FICC), San Francisco, California, 2019, 304-318.
- **Yunting Song**, Zhipeng Gui, Huayi Wu, Yangjiaxin Wei, "**A Web-based Framework for Visualizing Industrial Spatiotemporal Distribution Using Standard Deviational Ellipse and Shifting Routes of Gravity Centers**", Proceedings of ISPRS Geospatial Week 2017 Conference, Wuhan, China, 2017, 130-135.

Software

- Terrain Trees Library: an implementation of Terrain trees data representation and terrain analysis methods on Terrain trees
- Terrain Analysis on IA: an implementation of terrain analysis methods on the data structure with Adjacencies (IA data structure) as the baseline method for comparison
- Topology-aware mesh simplification on Terrain trees: an implementation of two new topology-aware simplification algorithms on Terrain trees
- Topology-aware mesh simplification on IA: an implementation of the topology-aware simplification on the IA data structure as the baseline method for comparison

Honors and Awards

- GIS Summer research fellowship, University of Maryland 2020
- Dean's Fellowship, University of Maryland 2018
- B Merit Scholarship (10%), Wuhan University, China 2015-2016

Teaching Experience

Lecturer:
- **GEOG 579 Introduction to GIS:** an introduction course to provide students with background on geographic information systems Summer 2021

Guest Lecturer:
- **CMSC498Q/GEOG498I/GEOG788I Algorithms for Geospatial Computing:** gave guest lectures on using python for handling geometric objects and on Terrain trees data representation.

Teaching Assistant:
- **CMSC828T Sorting in Space and Words and Foundations of Multidimensional and Metric Data Structures:** organized a workshop on spatial data handling and set up the website for it: https://spatialhandling-lectureseries.umiacs.io/
- **GEOG646** Programming for GIS (Python and JavaScript), **GEOG653** Spatial Analysis, **GEOG655** Spatial Database System (PostgreSQL), **GEOG306** Introduction to Quantitative Methods for the Geographical Environmental Sciences (R), **GEOG373** Geographic Information Systems, **GEOG170** Introduction to Methods of Geospatial Intelligence and Analysis, **GEOG 677** Web GIS

Skills

Programming Languages	C++, Python, R, SQL, JavaScript, HTML, CSS, Scala, MATLAB, Java
Tools/Techniques	MySQL, PostgreSQL, OpenMP, MPI, CGAL, Eigen, Apache Spark, Leaflet, ArcGIS, AutoCAD, Unity, ENVI, ERDAS, Git, Linux, LaTeX