Dayu Yu

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Research Interests

3D GIS; 3D City Modelling; GIService; Computer Graphics & Photogrammetry; High Performance Geo-computing.

Education

- Aug. 2023 – Aug. 2024: Visiting PhD. student in Urban Analytics Lab, Department of Architecture, **National University of Singapore**, Singapore
- Jun. 2020 – So far: PhD. Candidate in Cartography and Geographic Information Engineering, **Wuhan University**, China.
  Supervisor: Prof. Peng Yue (School of Remote Sensing and Information Engineering.)
- Sep. 2017 – Jun. 2020: M.Eng. in Survey and Mapping Engineering, **Fuzhou University**, China
  Supervisor: Prof. Liyu Tang (The Academy of Digital China)

Honors and awards

2023:

- The 24th Wang Zhizhuo Innovative Talent Award;
- China scholarship council (CSC) Scholarship

2022:

- **Top Prize** of Science and Technology Progress in Surveying and Mapping, Granted by Chinese Society for Geodesy, Photogrammetry and Cartography;
- **National Scholarship** for Doctoral Students, Granted by the Ministry of Education of the People's Republic of China;
- The Excellent Graduate of Wuhan University;

2021:

- The Second-Prize Award of Best Student Paper Competition, Granted by The 10th International Conference On Argo-Geoinformatics;
- One-hundred Outstanding Graduation Thesis of Fuzhou University;
- First-class Academic Scholarship Granted by Wuhan University;

2020:

- Outstanding Graduate of Fuzhou University;
- Special Award of Academic Scholarship Granted by Fuzhou University;

Skills

- Possess professional knowledge in fields such as GIS, geographic information services, photogrammetry, computer graphics (CG), computational fluid dynamics (CFD), and machine learning.
- Specialized in C++, Familiar with Python and JavaScript.
- Having project development experience in the following areas:
  - Development of desktop software and command-line toolkit in C++.
  - Development of Web application in JavaScript.
  - Deep Learning: PyTorch.
  - C++ Libraries: Qt, CMake, QMake, Vcpkg, OpenMP, etc.
  - 3D Visualization Libraries: OpenSceneGraph, VTK, Cesium, etc.
  - 3D Algorithm Libraries: The Computational Geometry Algorithms Library (CGAL), Point Cloud Library (PCL).
  - Cloud Computing: Kubernetes, Docker, Spark, Hbase, MinIO, Ray.
  - Computational Fluid Dynamics Library: OpenFOAM.

Research

Principle Investigator

1. **Unsupervised Semantic segmentation of realistic 3D Mesh based on machine learning**.

1) A robust cloth simulation method was proposed for filtering ground primitives from airborne-based 3D meshes. Experiments demonstrate that the method can accurately decompose the realistic 3D meshes into the 3D ground model and non-ground 3D model in an unsupervised manner, and it is a robust method suitable for different landscapes and is not impacted by vertex density and noise.
2) Propose a novel bidirectionally greedy framework to extract fine-grained building models in an unsupervised manner. Within the framework, non-building planes are culled greedily, without caring that some building primitives are deleted mistakenly. Afterward, a greedy recovery of mis-deleted building primitives is performed by the topological adjacency of the mesh and the topological isolation of above-ground objects from each other. The experimental results show that the accuracy and performance of the method even surpass that of supervised deep learning methods.

2. **Towards an Integrated Approach for Multi-source 3D Information Management in 3D Spatial Data Infrastructure**
   1） Present a cohesive mechanism that integrates the description, organization, management, and delivery of extensive and heterogeneous 3DSI, which in turn supports 3D data lifecycle management, retrieval, analysis, and streaming visualization within the framework of 3D SDI. We propose a data model for 3DSI management, based on scene graph structure. Then an encoding method is developed to map the data model to a schema suitable for cloud-optimized storage architectures, while also incorporating an SDI service interface to enable the FAIR principles
3. **Led team to develop Open Geospatial Engine (OGE)**.
   1） Successfully directed a team of 20 highly skilled graduate students in the development of the OGE, a cloud-native, large-scale remote sensing data analysis platform similar to Google Earth Engine. Upon its launch, the OGE will offer tens of petabytes of Analysis-ready remote sensing data, provide online analysis services of hundreds of GIS operators and models, and enable online programming capabilities for users.
4. **Semantic segmentation and object detection of remote sensing images based on DNNs**.
   2） Present a novel Local–global segmentation framework consisting of the dual-source fusion network and local–global transformer modules. The local–global transformer module is designed to capture fine-grained local features and coarse-grained global features, which enables the framework to focus on recognizing multiple-scale objects from the local and global regions.
   3） Propose a Dynamic Equilibrium Network for fire detection from remote sensing images, which achieves balanced knowledge transfer from old and to new datasets by imposing dynamic equilibrium constraints on the deeply-supervised model.
5. **Virtual geographic environment platform for tailings dam failure disaster simulation.**
   1） Building upon the physical properties of tailings flow, a mathematical model for simulating tailings dam failures was constructed based on computational fluid dynamics (CFD), adhering to the principles of mass and momentum conservation. The simulation was applied to the real-life example of the Feijão tailings dam breach in Brazil in 2019, achieving a result with an error margin of only 1.42% compared to the actual measured inundation area.
   2） Based on the concept of virtual geographic environment, a virtual geographic environment platform for dam failure disaster evolution simulation is designed, which can simulate and predicts the route and disaster-causing range of tailings after a failure, and visualize the results in a three-dimensional, dynamic and interactive manner.
6. **Contributed to the development of national/international standards as a drafter.**
   1) Contributed to the development of the OGC international standards: **OGC TrainingDML-AI**; https://www.ogc.org/projects/groups/trainingdmlswg;
   2) Contributed to two Chinese national standards: <Geographic Information, Digital Data and Metadata Preservation Part 1: Foundations> and < Geographic Information, Digital Data and Metadata Preservation Part 2: Content Specification for Earth Observation Data and Derived Products >
   3) Translate OGC CityGML Standard into Chinese: http://geos.whu.edu.cn/ogc/citygml/

Publications

National Invention Patents

[1] An automatic method for separating ground and non-ground models for realistic 3D models. No. ZL202110490354.9.

[2] Method, Apparatus, and Device for Spatiotemporal Correlation Analysis Based on Communication Big Data. No. ZL202210913511.7.

[3] Method, Apparatus, and Device for High-Performance Spatiotemporal Trajectory Correlation Analysis. No. ZL202210920158.5.

[4] Method, Apparatus, and Device for Plane Feature Detection from realistic 3D Models. **[Status: Substantive examination]**

[5] Method, Apparatus, and Device for Building Extraction from realistic 3D Models. **[Status: Substantive examination]**

[6] Method, Apparatus, and Device for High-Performance Electronic Fence Based on Communication Big Data. **[Status: Substantive examination]**

First / Corresponding Author

[1] **Yu D**, et al. Towards an Integrated Approach for Multi-source 3D Information Management in 3D Spatial Data Infrastructure. **[Under Manuscript]**.

[2] **Yu D**, Peng Y, Ye F, et al. Bidirectionally Greedy Framework for Unsupervised 3D Building Extraction from Airborne-based 3D Meshes[J]. *Automation in Construction*, 2023, 152: 104917.

[3] **Yu D**, He L, Ye F, et al. Unsupervised ground filtering of airborne-based 3D meshes using a robust cloth simulation[J]. *International Journal of Applied Earth Observation and Geoinformation*, 2022, 111: 102830.

[4] **Yu D**, Tang L, Ye F, et al. A virtual geographic environment for dynamic simulation and analysis of tailings dam failure[J]. *International Journal of Digital Earth*, 2021, 14(9): 1194-1212.

[5] **Yu D**, Tang L, Chen C. Three-dimensional numerical simulation of mud flow from a tailing dam failure across complex terrain[J]. *Natural Hazards and Earth System Sciences,* 2020, 20(3): 727-741. [JCR Q1, IF 4.580]

[6] Qiu L, **Yu D***, Zhang C, et al. A Local–Global Framework for Semantic Segmentation of Multisource Remote Sensing Images[J]. *Remote Sensing*, 2022, 15(1): 231.

[7] Wang M, **Yu D***, He W, et al. Domain-incremental learning for fire detection in space-air-ground integrated observation network[J]. *International Journal of Applied Earth Observation and Geoinformation*, 118: 103279, 2023.

[8] Qiu L, **Yu D***, Zhang C, et al. A Semantics-Geometry Framework for Road Extraction from Remote Sensing Images [J]. *IEEE Geoscience and Remote Sensing Letters*.

[9] Liu R, **Yu D*,** Yue P. A Disaster Information Service for Damaged Road Networks Using Dynamic Segmentation[C]//2022 10th *International Conference on Agro-geoinformatics*. IEEE, 2022: 1-6.

[10] **Yu D,** Tang L, Li X, et al. Visualization and Comparative Analysis of Radiation Therapy Data on Multiple Platforms Based on DICOM[J]. *Chinese Journal of Medical Physics*, 2019, 5. **[In Chinese]**

Co-Author

[1] A large scale training sample database system for intelligent interpretation of remote sensing imagery[J]. *Geo-spatial Information Science*, 2023: 1-20.

[2] Optimal design of plant canopy based on light interception: a case study with loquat[J]. *Frontiers in Plant Science*, 2019, 10: 364.

[3] Spatial-Temporal Diffusion Convolutional Network: A Novel Framework for Taxi Demand Forecasting[J]. *ISPRS International Journal of Geo-Information*, 2022, 11(3): 193.

[4] A provenance-aware method for updating Earth Observation training data[C]//2022 *10th International Conference on Agro-geoinformatics*. IEEE, 2022: 1-6.

[5] Quality considerations for AI training data: case studies on semantic segmentation of EO imagery[C]//2022 *10th International Conference on Agro-geoinformatics*. IEEE, 2022: 1-6.

[6] OGEScript: an OGC-oriented Interoperable Script API for Online Geospatial Analysis [C]//2023 *11st International Conference on Agro-geoinformatics*. IEEE, 2023: 1-6.

[7] A Geospatial Data and Model Hub for Online Geospaital Analysis [C]//2023 *11st International Conference on Agro-geoinformatics*. IEEE, 2023: 1-6.

[8] A Cube-enabled Cloud Geoprocessing Engine for Big Earth Data [C]//2023 *11st International Conference on Agro-geoinformatics*. IEEE, 2023: 1-6.

[9] Personalized Scenic Spot Recommendation Method Based on Geotagged Photos[J]. *Journal of Geo-Information Science, 2021*. [In Chinese]