Patrick Xinghua CHENG

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Research Interests

Shannon Entropy, Thermodynamic Entropy, Communication Theorems, Statistical Thermodynamics, Deep Learning in Remote Sensing.

Education

M.S. Geographical Information System (with distinction) Sept 2018 - Feb 2020
The Department of Land Surveying and Geo-Informatics, The Hong Kong Polytechnic University

- Thesis: Entropy-based models for predicting lossless compression ratio of remote sensing images: from Shannon back to Boltzmann
- Grade: A+
- Advisor: Chair Prof. Zhi-lin LI

B.S. Geographical Information Science (with distinction) Sept 2014 - June 2018
The Department of Geographical information Science, Nanjing Normal University, China

- Thesis: Spatial temporal modelling for district: A case study in Nanjing, China
- Grade: A+
- Advisor: Prof. Nan JIANG, Prof. Di HU

Research Experience

Research Associate at department of land surveying and geo-informatics, HK PolyU

Advisor: Chair Prof. Zhi-lin LI
(https://scholar.google.com.hk/citations?user=rUJycAoAAAAJ&hl=en)

- **Project title: Development of Boltzmann-entropy-based image approaches for remote sensing image analysis** (*supported by a grant from the research grant council of Hong Kong Special Administrative Region*)
  - Responsible for developing novel and powerful methods of calculating Boltzmann entropy.
  - **Engineered Boltzmann entropy-based models for predicting lossless image compression ratio.**
  - **Investigated the information transmission from multispectral remote sensing image to land cover maps with a statistical thermodynamics-based approach.**
  - **Surveyed the statistical thermodynamics in remote sensing image classification**
  - Responsible for the development of statistical thermodynamics-based deep learning approaches for remote sensing image analysis.

Advisor: Dr. Yan Wei Yeung

(http://www.lsgi.polyu.edu.hk/people/academic/yan-wai-yeung/index.asp)

- **Project title: The next-generation global land cover map: a multispectral LiDAR approach** (*supported by a grant from the research grant council of Hong Kong SAR*)
  - **Addressed the issue of measuring the information loss for point clouds denosing with an information-theoretic approach.**
  - Development of information fusion approaches of multispectral point clouds and remote sensing images for land cover mapping.

Research Assistant in "Yangtze River Delta Science Data Center，National Earth System Science Data Sharing Infrastructure" (June 2016 - June 2018)

Advisor: Prof. Nan JIANG and Associate Prof. Di HU

- **Project title: A Spatial Temporal Framework Construction and Service of Nanjing over the Past Hundred Years** (*supported by a grant from the Jiangsu provincial bureau of surveying mapping and geoinformation, China*).
  - Participated in the development of web platform of service of Nanjing.
  - Analyzed the changes of Nanjing district over the past century.
- **Project title: Spatial Temporal Modeling and Positioning Approach of Historical Geographic Information** (*supported by a grant from the national science foundation of People's Republic of China*).
  - Screened data for preliminary studying of spatial temporal modeling.
  - Engineered two approaches for positioning historical geographic information.
- **Project title: Multi-granularity Spatial Temporal Object Expression Model** (Sub-Topics of Pan-spatial Information System and Intelligent Facilities Management, *supported by a grant from the national science foundation of People's Republic of China*)
  - Responsible for district-based spatial temporal modeling, and for the writing of portions of manuscript that came out of this project.
  - Investigated the data structures for storing spatial temporal data of district.

Achievements:

- **Research Paper**
  - **Cheng, X. H**, Li, Z. L., Configurational Entropy for Optimizing the Encryption of Digital Elevation Model Based on Chaos System and Linear Prediction. Applied Science, 11(5), pp. 2402, Doi:10.3390/app11052402**.**
  - **Cheng, X. H**, Li, Z. L., 2021. Predicting the Lossless Compression Ratio of Remote Sensing Images with Configurational Entropy. *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*. Doi:10.1109/JSTARS.2021.3123650.
  - Li, S. J, Hu, G. H, **Cheng, X. H**, Xiong, L. Y, Tang G. N. Josef S., Integrating topographic knowledge into deep learning for the voids filling of digital elevation model. *Remote Sensing of Environment* (Accepted for publication)
  - **Cheng, X. H**, Li, Z. L., A Generalized Law of Energy Conservation for Mapping from Multispectral Remote Sensing Imagery. (In preparation).
  - **Cheng, X. H**, Li, Z. L., 2021. An Information-Theoretic Method for Evaluating Lossless Compression Techniques Applied to Remotely Sensed Data. (In preparation).
  - **Cheng, X. H**, Li Z. L., 2020. How Does Shannon's source coding theorem Fare in prediction of image compression ratio with current algorithms? In *ISPRS Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, Doi: 10.5194/isprs-archives-XLIII-B3-2020-1313-2020.
  - **Cheng, X. H**, Li, Z. L., 2020. Using Boltzmann Entropy to Measure Scrambling Degree of Grayscale Images. In *Proc.* the 2021 IEEE 5th International Conference on Cryptography, Security and Privacy (CSP 2021), Zhuhai, China, pp. 181-185, Doi: 10.1109/CSP51677.2021.9357492.
  - **Cheng, X. H**, Hu, D, Zhu, A. X., Lü, G. N., 2021. An Automatic Approach for Acquiring the Inputs and Outputs of Geographical Models. *Environmental Modeling & Software* (in review).
  - **Cheng, X. H**, Hu D, Yu, Z. Y, Long, Y, Zhou, R. C., 2017. Modeling spatial temporal object of multi-granularity for district and its implementation by geodatabase. *Journal of Geo-information Science*, vol 19, no. 9, pp. 1228-1237, Doi: 10.3724/SP.J.1047.2017.01228.
  - Hu, H. Y, Hu, D, **Cheng, X. H** and Wang, Q. R., 2018. Design and Implementation of a Public-Facing Three Kingdoms Historical WebGIS. *Journal of Nanjing Normal University (Engineering and Technology Edition)*, vol 18, no. 1, pp. 71-78, Doi: 10.3969/j.issn.1672-1292.2018.01.010.

- Zhou, R. C, Lu, K., Long, Y., Lu, J. Y, **Cheng, X. H**, Hu, D. and Gu, Y.H., 2017. A survey on social image understanding. In *Proc*. *2017* IEEE *International Conference on Behavioral, Economic, Socio-cultural Computing (BESC)*, Krakow, Poland, pp. 1-5 Doi*: 0.1109/BESC.2017.8256394*.

- **Book Chapter**
  - Hu, D, **Cheng, X. H**, Lü, G. N, Wen, Y. N, Chen, M., 2020. The Chinese Family Tree Geographical information system. In: *Ye, X.Y, Lin, H. eds. Spatial Synthesis: Computational Social Science and Humanities*. Switzerland: Springer Nature, pp. 13-17, Doi: 10.1007/978-3-030-52734-1_3.

Work and Teaching Experience

Research Assistant Dec 2018 - Feb 2020

Research Associate Mar 2020 – 20 Dec 2021 (expected)

- Affiliation: The Department of Land Surveying and Geo-Informatics, The Hong Kong Polytechnic University, Hong Kong SAR.

Teaching Assistant Sept 2020-Current

- Course Name: LSGI3242A Digital Terrain Modelling (Sept 2020-Dec 2020)
  - Instructor: Dr. Yan Wai Yeung
  - Responsibility**:** Lab Teaching, Assignments Marking
- Course Name: LSGI3244A_535_20202_A Spatial Data Analysis and Mining (Jan 2021- May 2021)
  - Instructor: Dr. Xiao-lin ZHU
  - Responsibility: Lab Teaching, Assignments Marking

Society Membership

- North American Regional Association of the International Association for Landscape Ecology (IALE-NA) Student Membership.
- International Society for Photogrammetry and Remote Sensing (ISPRS)
- AAG (American Association of Geographers) Graduate Student Membership.
- Institute of Electrical and Electronics Engineers (IEEE) Geoscience and Remote Sensing Student Membership.

Oral Presentation

Cheng, X. H, Li, Z. L "Effects of Upscaling Functions on Calculating Thermodynamic Entropy of Numerical Raster Data: A Case Study on Aggregation". In *T-08: Modeling, North American Regional Association of the International Association for Landscape Ecology (IALE-NA) Annual Meeting*, Neveda, USA, April 8-16, 2021. (Online).

Cheng, X. H, Li, Z. L. "Boltzmann-entropy-based Optimization of Encryption and Decryption of DEM with Logistic Map". In *Special Symposia-07: Entropy for landscape ecology: models, computation, and applications, North American Regional Association of the International Association for Landscape Ecology (IALE-NA) Annual Meeting*, Toronto, Canada, May 10-14, 2020. (Online).

Cheng, X. H, Li, Z. L. "Using Boltzmann Entropy to Measure Scrambling Degree of Grayscale Images". In *2021 IEEE 5th International Conference on Cryptography, Security and Privacy (CSP 2021), Zhuhai, China, January 8-10, 2021*.

Cheng, X. H, Li, Z. L. "Measung the Srambling Degree of Remote Sensing Imgaes: A Perspective from The Second Law of Thermodynamics". In *2020 International Graduate Workshop on Geoinformatics*, Wuhan, China, December 16-18, 2020.

Cheng, X. H, Li, Z. L. "How Does Shannon's source coding theorem Fare in prediction of image compression ratio with current algorithms?" *XXIVI International Society for Photogrammetry and Remote Sensing (ISPRS) Congress 2020*, Nice, France, June 14-20, 2020.

Cheng, X. H, Hu, D, He, H. Y, Wang, Q. R. "Publicly-oriented Historical Geographical Information System of Three Kingdoms". *Digital Humanities: Academic Frontiers and Explorations in the Big Data Era" Symposium*, Nanjing, People's Republic of China, July 1-3, 2017.

https://digitalhumanities.nju.edu.cn/meeting/5d8e0e1a3e22dbed8f/.

Academic Conference Experience

- IALE-NA Annual Meeting, (2020 Toronto, Canada).
- XXIV ISPRS Congress 2020, (2020 Nice, Fance).
- The Second International Conference on Urban Informatics (2019 Hong Kong, China).
- ESRI China Developer Summit (2017 Beijing, China).
- The Eighth National Conference of Cartography and Geographical Information System (2016 Nanjing, China).
- ISPRS Geospatial Week (2017 Wuhan, China).

Honor & Awards

- LSGI Scholarship for Outstanding Academic Performance, The Hong Kong Polytechnic University (2018-2019).
- Nomination of Entry Scholarship of Faculty of Construction and Environment, The Hong Kong Polytechnic University (2018-2019).
- Outstanding Undergraduate Thesis of Nanjing Normal University, Sept 2018.
- Third-class Scholarship for Excellent Student, Nanjing Normal University, 2015
- Award of Pacemaker to Merit Student, Nanjing Normal University, December 2015.
- Third-class Scholarship for Excellent Student, Nanjing Normal University, 2016
- Second-class Scholarship for Excellent Student, Nanjing Normal University, 2017.
- Third-class Scholarship for Excellent Student, Nanjing Normal University, 2018
- Second Prize in the 5th National GIS Skills Competition (Qingdao, China), November 2016.
- Second Prize in the Mapping Group of Nanjing Normal University Campus Invitational Tournament of the 14th National University GIS Competition, Sept 2016.

Professional Skills

- Programming Languages: Python, R, C, C#, C++, Java, HTML5, JavaScript, Matlab
- Deep Learning Frameworks: Tensorflow, PyTorch.
- Operating System: Windows families, MacOS, Linux families.
- Databases: Oracle, Mysql, SQLite, PostgreSQL, SqlServer, ESRI Geodatabase.
- Software and Tools: Android Studio, MATLAB, Visual Studio, Eclipse, IntelliJ, ArcGIS, ENVI, Smart3D, AutoDesk 3ds Max, Level, Total Station, GPS, Theodolite, DJ UAV (Unmanned Aerial Vehicle).