



## Fangwen Yu

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### Overview

Mr Fangwen Yu is a researcher of 3D cognitive navigation in robotics and neuroscience for the real world. His career vision is to **create robots that navigate like humans do** inspired by the brain.

His research models the neural mechanisms in the brain underlying tasks like 3D navigation and 3D spatial cognition to develop new neuromorphic 3D SLAM and 3D cognitive navigation technologies for land, sea, air, space-based autonomous robots and vehicles. He is currently working on the project of NeuroSLAM. His supervisors are [Prof. Michael Milford](#), [Prof. Jianga Shang](#), [Prof. Youjian Hu](#).

### Research Highlight

Fangwen currently leads the NeuroSLAM project ([www.neuroslam.net](http://www.neuroslam.net)) which is creating robots that navigate like humans do with a long-term goal. The project aims to model the neural mechanisms in the brain underlying tasks like 3D navigation and 3D spatial cognition to develop new neuromorphic 3D SLAM and 3D cognitive navigation technologies for land, sea, air and space based autonomous robots and vehicles.

The project has developed a novel brain-inspired SLAM (simultaneously localization and mapping) system for 3D environments, named NeuroSLAM. The system is implemented based upon computational models of 3D place cells, 3D grid cells and 3D head direction cells, integrated with a vision system that provides external visual cues and 3D self-motion cues. NeuroSLAM's neural network activity drives the creation of a 3D graphical experience map in a real-time, enabling relocalization and loop closure through sequences of familiar local visual cues. Using both synthetic and real-world datasets comprising complex, 3D indoor and outdoor environments, they demonstrate NeuroSLAM consistently producing topologically correct three-dimensional maps.

They are developing and extending the NeuroSLAM models based on the further discoveries of neural basis of 3D navigation, e.g. 3D goal-directed cells, time cells, speed cells, episodic memory, enabling the robots to

navigate in complex 3D environments. In the future, they plan to deploy the NeuroSLAM models based on brain-inspired chips, e.g. Tianjic Chip, or neuromorphic hardware. Finally, they will develop a novel intelligent robot that navigate based on the artificial 3D navigation brain.

For further information, please visit their project website at [www.NeuroSLAM.net](http://www.NeuroSLAM.net).

## Education

2017/08-2019/08	3D Cognitive Navigation (NeuroSLAM)	Queensland University of Technology, Australian Centre for Robotic Vision, Australia	Visiting Ph.D. Student
2015/09-Now	Survey and Mapping (Brain-inspired Navigation)	China University of Geosciences, Wuhan National Engineering Research Center for GIS	Ph.D. Student
2012/09-2015/06	Computer Science (Indoor Positioning and Navigation)	China University of Geosciences, Wuhan	M.A.
2008/09-2012/06	Software Engineering (Indoor Positioning and Navigation)	China University of Geosciences, Wuhan	B.S.
2010/06-2012/06	Business Administration (Innovative Team Management)	Huazhong University of Science and Technology	B.S.

## Selected Research Projects

- [1] China & Australia. **NeuroSLAM: A Brain Inspired SLAM System for 3D Environments**. (Leader) 2016.09- Now
- [2] China. National Key Program of Research and Development Plan, Grant No. 2016YFB0502200 (important participant). **Smart Hybrid Indoor Localization with High Degree of Accuracy and Availability and Indoor GIS**. 2016.07-2020.12.
- [3] China. National Natural Science Foundation, Grant No. 41271440 (important participant). **Multi-Layered Semantic Location Model in Ubiquitous Computing Environments**. 2013.01-2016.12
- [4] China. Fundamental Research Funds for National University, China University of Geosciences (Wuhan), Grant No. 1610491T08 (Leader). **Student Innovation Research Team, Research on Wearable Cognitive Navigation**. 2015.12-2017.12.
- [5] China. Fundamental Research Funds for National University, China University of Geosciences (Wuhan), Grant No. 1310491B07 (Leader). **Research on Context Aware Indoor Positioning and Navigation**. 2013.03-2014.03
- [6] China. Teaching Lab Open Funds, China University of Geosciences (Wuhan), Grant No. SKJ2012190 (Leader). **Research on Indoor Spatial Model for Navigation and Positioning Applications**. 2012.12-2013.12
- [7] China. Fundamental Research Funds for National University, China University of Geosciences (Wuhan), Grant No. CUGL090247 (important participant). **UbiEyes: Universal Real-time Locating System**. 2011.06-2013.06
- [8] China. Teaching Lab Open Funds, China University of Geosciences (Wuhan), Grant No. SKJ2011186

(Leader). **Testing Methods and Experiments of Dynamic Positioning Accuracy**. 2011.08-2012.06

## **Selected Published Papers**

- [1] Fangwen Yu, Jianga Shang, Youjian Hu and Michael Milford. **NeuroSLAM: A Brain inspired SLAM System for 3D Environments**. Biological Cybernetics, 2019, <https://doi.org/10.1007/s00422-019-00806-9>
- [2] Fuqiang Gu, Kouros Khoshelham, Jianga Shang, Fangwen Yu, Zhuo Wei. **Robust and Accurate Smartphone-based Step Counting for Indoor Localization**[J], IEEE Sensors Journal, 2017, 17(11): 3453-3460. <https://doi.org/10.1109/JSEN.2017.2685999>
- [3] Jianga Shang, Xinyi Tang, Fangwen Yu, Feng Liu. **A Semantics-based Approach of Space Subdivision for Indoor Fine-grained Navigation** [J]. Journal of Computational Information Systems, 2015, 11(9): 3419- 3430.
- [4] Xin Wang, Jianga Shang, Fangwen Yu, Jinjin Yan. **Indoor Semantic Location Models for Location-Based Services** [J]. International Journal of Smart Home, 2013, 7(4): 127-136.
- [5] Jinjin Yan, Jianga Shang, Fangwen Yu, Xinyi Tang, Zhiyong Zhou. **Analysis of Indoor Spatial Structure and Mapping methods for Real-time Localization** [J]. Geomatics and Information Science of Wuhan University. 2016, 41(8):1-12.
- [6] Fangwen Yu, Zhiyong Zhou, Xiaonan Wang, Xiao Zhang, Jianga Shang. **An Indoor Navigation Location Model Fused Various of Context For Emergency Evacuation** [J]. Application Research of Computers, 2014, 31(4):981-984, 1000. (in Chinese)
- [7] Zhiyong Zhou, Fangwen Yu, Jianga Shang, Xiao Zhang, Xiaonan Wang. **An Indoor Map Visualization Method of the Real-time Location Monitoring System** [J]. Science of Surveying and Mapping, 2015, 40(11):177-181. (in Chinese)
- [8] Zhiyong Zhou, Jianga Shang, Fangwen Yu. **An Emergency Evacuation Navigation System Based on Indoor Positioning Technology** [J]. Application Research of Computers, 2015. (in Chinese)
- [9] Bin Ge, Jianga Shang, Fangwen Yu, Xuke Hu, Ao Guo. **A Visualization Framework of Real-time Locating System by the Fusion of WebGIS and Web3D Technologies** [J]. Computer Applications and Software, 2015, 32(1):68-70,117. (in Chinese)
- [10] Xuke Hu, Jianga Shang, Fuqiang Gu, Fangwen Yu, Bin Ge, Ao Guo. **Development of Indoor/ Outdoor Seamless Positioning Prototype System Fusing GPS and Wi-Fi** [J]. Journal of Chinese Computer Systems, 2014, 35(2): 428-432. (in Chinese)
- [11] Jinjin Yan, Jianga Shang, Fangwen Yu, Xin Wang. **A Method of Building A 3D Indoor-Oriented Positioning Building Model**[J]. Computer Applications and Software, 2013, 30(10):16-20. (in Chinese)
- [12] Fangwen Yu, Jianga Shang, Fuqiang Gu, Xuke Hu. **Study on Dynamic Positioning Accuracy of Testing Methods and Experiments** [J]. Measurement & Control Technology, 2012, 31(1): 16-20. (in Chinese)
- [13] Fuqiang Gu, Jianga Shang, Pingyuan Chen, Xuke Hu, Fangwen Yu. **Mobile Target Positioning Algorithm Based on Particle Filter** [J]. Systems Engineering -Theory& Practice, 2011, 31(S2): 186-190. (in Chinese)
- [14] Jianga Shang, Ao Guo, Fuqiang Gu, Xuke Hu, Fangwen Yu. **A Real-time Positioning Middleware Combining Multiple Strategies for Improving Positioning Precision** [J]. Computer Applications and Software, 2011, 28(12): 44-47. (in Chinese)
- [15] Fangwen Yu, Xuke Hu. **The New Technology and Application about nanoLOC based CSS**[J]. Information & Communications, 2011, (2):10-12. (in Chinese)

## **Seclected Conferences Papers**

- [1] Fuqiang Gu, Kourosh Khoshelham, Jianga Shang, and Fangwen Yu. **Sensory Landmarks for Indoor Localization**[C]. In: Proceedings of The Fourth International Conference on Ubiquitous Positioning, Indoor Navigation and Location-based Service 2016 (UPINLBS 2016). Shanghai(China). November 3-4, 2016.(Best Paper Award)
- [2] Zhiyong Zhou, Fangwen Yu, and Jianga Shang. **iGeoNoti: A Fine-grained Indoor Geo-notification System**[C]. In: Proceedings of The Fourth International Conference on Ubiquitous Positioning, Indoor Navigation and Location-based Service 2016 (UPINLBS 2016). Shanghai(China). November 3-4, 2016.
- [3] Xin Wang, Jianga Shang, Fangwen Yu, Jinjin Yan. **Research on Semantic Location Models for Indoor Location-Based Services** [C]. In the 4th International Conference Ubiquitous Computing and Multimedia Applications (UCMA), Advanced Science and Technology Letters (ASTL) [C], 2013, 22: 47-52.
- [4] Jianga Shang, Xuke Hu, Ao Guo, Fangwen Yu, Bin Ge. **Ubiquitous Location Aware Technology and Services Framework in Indoor Space**[C]. In the Fifth College GIS Forum, 2014. (Best Paper, in Chinese)

## **Seclected Patents (7 granted)**

- [1] Jianga Shang, Fangwen Yu, Xuke Hu, etc. **Context-aware Emergency Indoor Navigation System and approaches**. China Invention Patent, No: CN 2014 1 0156123.4. (Granted in June 15 2016)
- [2] Jianga Shang, Xuke Hu, Fangwen Yu, etc. **Improving Wi-Fi Indoor Positioning via AP Sets Similarity and Semi-Supervised Affinity Propagation Clustering**. China Invention Patent, No: CN 2013 1 0432808.2. (Granted in March 23 2016)
- [3] Jianga Shang, Fangwen Yu, Xinyi Tang, etc. **A Generation Method of Dynamic Path for Indoor Navigation**. China Invention Patent, No: CN 201510449347.9. (Granted in Sep. 26 2017)
- [4] Jianga Shang, Fangwen Yu, Xinyi Tang, etc. **Relative Location-aware Query of Indoor Moving Objects**. China Invention Patent, No: CN 201610034743.2. (Granted in March 8 2019)
- [5] Jianga Shang, Wen Cheng, Yongfeng Wu, Fangwen Yu, Zhiyong Zhou. **A Generation Approach of Graph Model for Indoor Positioning and Navigation**. China Invention Patent, No: CN201610545874.4. (Granted in Feb 1 2019)
- [6] Jianga Shang, Fuqiang Gu, Fangwen Yu. **An Approach of Step Count and Electric Devices**. China Invention Patent, No: CN201610325891.7. (Granted in Feb. 26 2019)
- [7] Jianga Shang, Zhiyong Zhou, Fangwen Yu, Xinyi Tang, Yongfeng Wu, Wen Cheng. **Indoor Social Navigation System**. China Invention Patent, No: CN201610338026.6. (Granted in April 23 2019)
- [8] Jianga Shang, Zhiyong Zhou, Fangwen Yu, Xinyi Tang, Yongfeng Wu, Wen Cheng. **A System of Nearest Neighbor Location Query for Indoor Environments**. China Invention Patent, No: CN201610335134.8.
- [9] Jianga Shang, Zhiyong Zhou, Fangwen Yu, etc. **A System of Indoor Mobile Social Service Network**. China Invention Patent, No: CN201610338027.0.
- [10] Jianga Shang, Zhiyong Zhou, Fangwen Yu. **A Fine-grained Indoor Geo-notification System in Multi-floor Building**. China Invention Patent, No: CN201710089893.5.

## **Seclected Software Systems**

- [1] Jianga Shang, Fangwen Yu, Xuke Hu, etc. **SmartENavi: Context-aware Indoor Emergency Navigation System**. Computer Software Copyright, No: 2014SR087245.

- [2] Jianga Shang, Fuqiang Gu, Fangwen Yu, etc. **UbiEyes: Universal Real-time Locating System**. Computer Software Copyright, No: 2013SR055149.
- [3] Jianga Shang, Zhiyong Zhou, Fangwen Yu, etc. **iSoNe: An Indoor Location-based Mobile Social Network System**.

### **Selected Honors and Awards**

- 2019.10 ¥300,000 Innovation Grand Prize at the 2019 International Collegiate Competition for Brain-inspired Computing
- 2016.11 IEEE UPINLBS 2016 Best Paper Award
- 2016.09 ¥120,000 Fund, Hubei Province Collegiate Competition for Innovation and Entrepreneurship
- 2016.05 The Ten Pioneers of Innovation and Entrepreneurship in CUG
- 2015.11 Best Presentation Awards in China National PhD Academic Forum of Surveying and Mapping
- 2015.06 The Outstanding Volunteer of the 23rd International Conference on Geoinformatics
- 2014.11 The New Star of GIS in the National College GIS Forum, China
- 2014.10 National Scholarship for Graduate Students
- 2013.10 Second Class Prize in the 13th “Challenge Cup” National University Student Curricular Academic Science and Technology Works Competition
- 2013.12 The Grand Prize in the Graduate Academic Competition of CUG
- 2013.12 Hi-Target Survey Instruments Company Innovation Scholarship
- 2013.06 First Class Prize in the 9th “Challenge Cup” Hubei Province College Curricular Academic Science and Technology Works Competition
- 2013.06 The Ten Outstanding Graduate Student Pacesetter at CUG
- 2012.12 Spatial Information Outstanding Innovation Scholarship
- 2012.06 Taihua Company Innovation Scholarship

### **Selected Professional Experience**

- 2015/10-2017/10 **Team Leader** Innovation Research Team of Cognitive Navigation at CUG  
The innovation research team of intelligent navigation is mainly focusing on research and development of intelligent indoor positioning and navigation for wearable devices, like smart glasses, smart watches, smart wrists. We are developing a wearnav system based on hybrid indoor positioning technologies including the approaches of Wi-Fi, BLE, PDR, Vision, and Spatial-aided localization.
- 2012/09-2017/09 **Lab Leader Assistant** UbiLoc Lab at China University of Geosciences  
The UbiLoc lab (Ubiquitous Location-Aware Computing Lab) founded in 2009. The research areas include indoor positioning, indoor navigation, indoor GIS and Mapping, indoor social network, etc.
- 2012/09-2013/09 **President** Software Association of China University of Geosciences
- 2012/09-2013/09 **Vice President** Graduate Student Union of Faculty of Information and Engineering

### **Selected Conferences Attended**

- 2018 IEEE International Conference on Robotics and Automation (ICRA2018), May 21-26, 2018, Brisbane, Australia

2017 China Satellite Navigation Conference (CSNC 2017), May 23-25, 2017, Shanghai, China.  
2017 Global Artificial Intelligence Technology Conference (GAITC 2017), May 21, 2017, Beijing, China  
2016 The Fourth International Conference on Ubiquitous Positioning, Indoor Navigation and Location-based Service 2016 (IEEE UPINLBS 2016), Nov.3-5, Shanghai, China  
2016 China Satellite Navigation Conference (CSNC 2016), May 18-20, 2016, Changsha, China.  
2015 International Conference on Ubiquitous Surveying, Mapping and Big Data of Locations, November 6-8, 2015, Wuhan, China.  
2015 China National Computer Congress (CNCC 2015), October 22-24, 2015, Hefei, China.  
2015 The 23rd International Conference on Geoinformatics (Geoinformatics 2015), June 18-20, 2015, Wuhan China.  
2014 ISPRS Geospatial Database and Location Based Services, May 14-16, 2014, Suzhou, China.  
2014 China Satellite Navigation Conference (CSNC 2014), May 17-19, 2014, Wuhan, China.  
2014 Geospatial Information for Smart City and the Future of Geoinformatics, May 15-16, 2014, Wuhan, China.

### **Selected Conference Presentations**

- [1] Fangwen Yu. **Sensory Landmarks for Indoor Localization**. IEEE UPINLBS 2016, Best Paper Award.
- [2] Fangwen Yu. **Approaches and Applications of Continuous Relative Location-Aware Query for Indoor Pedestrians**. China National PhD Academic Forum of Surveying and Mapping, 2015. Best Presentation Award
- [3] Fangwen Yu. **Research on Indoor Semantic Location Model for Intelligent Navigation**. ISPRS Geospatial Database and Location Based Services, Workshop of 3D Indoor Modelling and Navigation, 2014.

### **Membership**

- Member of IEEE
- Member of IEEE Robotics and Automation Society (IEEE-RAS)
- Member of IEEE-RAS Technical Committee on Cognitive Robotics
- Member of IEEE-RAS Technical Committee on Neuro-robotics Systems
- Member of Royal Institute of Navigation (RIN)
- Member of China Computer Federation (CCF)
- Member of Chinese Association for Artificial Intelligence (CAAI)

### **Language Skills and Computer Background**

- **English level:** full professional proficiency
- **Chinese level:** native speaker
- **Programming Languages:** Java, C++, C, Python, etc. (under ROS, Linux, Windows)
- **Programming Methodologies:** OO Design, Common Design Pattern, RUP
- **Databases:** MySQL, PostgreSQL, Oracle
- **Web Technologies:** Apache, Java Servlets, JavaScript, etc.
- **Mathematic Tools:** MATLAB