

# YUNMEI LIU

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## EDUCATION

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### **Ph.D. in Industrial & Systems Engineering**

2019 – August 2023 (Expected)

University of Florida, *Gainesville, U.S.*

Ph.D. Minor: Statistics

Specialization: Human Factors and Systems Engineering

Dissertation title: Quantitative models for system rate of automation and operator situation awareness responses

Academic advisors: Dr. David B. Kaber

### **M.S. in Management Science and Engineering**

2016 – 2019

Nanjing University, *Nanjing, China*

Specialization: Transportation Systems Analysis and Modeling

Graduate thesis title: User equilibrium in stochastic networks considering decision inertia

Academic advisors: Dr. Hongli Xu

### **B.S. in Industrial Engineering**

2012 – 2016

Shandong University, *Jinan, China*

Academic advisors: Dr. Honglin Zhang

## RESEARCH INTERESTS

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My research interests focus on using the principles of human factors and systems engineering to design, analyze, and model human-in-the-loop systems. I specialize in the intersection of human factors, ergonomics, transportation engineering, statistics, and computer science. Specifically, my research areas include:

1. **Modeling human-automation interaction and human performance**  
Develop quantitative models of human-automation interaction, human cognitive workload, situation awareness, and task performance in the human-in-the-loop systems, which can solve practical problems and be verified by experiments.
2. **Addressing human factors in surface transportation**  
Design or improve the use and placement of interchange guidance signs, on-road and in-vehicle delivery of service signs, and the use and interaction of in-vehicle technologies through driving experiments (field studies or simulated driving).
3. **Improving usability of assistive technologies**  
Experimentally test the effects of different assistive technologies on user task performance, cognitive workload, and usability assessments, providing information to improve the design of their control interfaces.
4. **Predicting human cognitive or physical states**  
Develop algorithms to process multiple physiological signals in real time, applying advanced techniques such as feature engineering and machine learning to predict the cognitive workload and emotional states of users under extreme conditions.
5. **Identifying and measuring system hazards and risks**

Develop methods to identify system hazards and risks with severity levels of their consequences. Applications include transportation, healthcare, and manufacturing systems.

## PUBLICATIONS

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### Refereed Book Chapter (accepted or published)

1. Kaber, D. B., **Liu, Y.** & Lau, M. Y. (accepted). Considering Severity of Safety-Critical System Outcomes in Risk Analysis: An Extension of Fault-Tree Analysis. In J-C. Le Coze & S. Antonsen, *SpringerBriefs in Safety Management - Safety in a Digital Age: Old and New Problems*. Cham, Switzerland: Springer.

### Refereed Journal Papers (accepted or published)

2. Park, J., Berman, J., Dodson, A., **Liu, Y.**, Armstrong, M., Huang, H., Kaber, D. B., Ruiz, J., and Zahabi, M. (accepted). Assessing workload in using electromyography (EMG)-based prostheses, *Ergonomics* (5/31/23).

### Refereed Journal Papers (under review/revision)

3. **Liu, Y.** & Kaber, D. B. (in 2<sup>nd</sup> review). Models of automation rate in human-in-the-loop systems and operator situation awareness responses. Submitted to *IEEE Transactions on Human-Machine Systems* (12/31/21).
4. **Liu, Y.**, Berman, J., Dodson, A., Park, J., Zahabi, M., Huang, H., Ruiz, J., and Kaber, D. B.. (in 2<sup>nd</sup> review). Human-centered evaluation of EMG-based upper-limb prosthetic control modes. Submitted to *IEEE Transactions on Human-Machine Systems* (11/15/22).
5. Lau, M., **Liu, Y.** & Kaber, D. B. (in 2<sup>nd</sup> review). A consequence severity-probability importance measure for fault tree analysis. Submitted to *International Journal of System Assurance Engineering and Management* (10/03/22).
6. Zhang, W., **Liu, Y.** & Kaber, D.B. (in 1<sup>st</sup> revision). Effect of interface design on cognitive workload in unmanned aerial vehicle control. Second revision submitted to *Int. J. of Human Computer Studies* (4/12/21).

### Refereed Journal Papers (in preparation)

7. **Liu, Y.**, Pyo, K., Cunningham, C., Chase, T., Kaber, D. B.. Novel interchange configurations and associated signage assessment. Target journal: *Applied Ergonomics*.
8. **Liu, Y.**, Yang, G., Pyo, K., Cunningham, C., Chase, T., Kaber, D. B.. Design consistency. Target journal: *Applied Ergonomics*.
9. **Liu, Y.** and Kaber, D. B.. Validity assessment for a SA response function in level of automation. Target journal: *Human Factors*.
10. **Liu, Y.** and Kaber, D. B.. Effects of driver experience and level of vehicle automation on SA, workload and performance. Target journal: *Applied Ergonomics*.
11. **Liu, Y.**, Grimaldi, N. S., Wozniak, D., Chen, E., Zahabi, M., and Kaber, D. B.. Integration of cognitive workload modeling and physiological responses for real-time user state classification. Target journal: *IEEE Transactions on Human-Machine Systems*.

### Refereed Conference Papers (published in proceeding)

- C1. **Liu, Y.**, Kaber, D. B., Sabahi, S., and Cunningham, C.. Machine learning models of erroneous driver actions at novel interchange configurations, *2022 IEEE 3rd International Conference on Human-Machine Systems (ICHMS)*, 2022, pp. 1-6.

- C2. **Liu, Y.**, Pyo, K., Cunningham, C., Chase, T. and Kaber, D. B.. Driver situation awareness and cognitive workload effects of novel interchange configurations and associated signage, *13th International Conference on Applied Human Factors and Ergonomics (AHFE)*, 2022; 60: 287-296.
- C3. **Liu, Y.** and Kaber, D. B.. Quantitative models for automation rate and situation awareness response: A case study of levels of driving automation, *2021 IEEE 2nd International Conference on Human-Machine Systems (ICHMS)*, 2021, pp. 1-6.
- C4. Park, J., Berman, J., Dodson, A., **Liu, Y.**, Matthew, A., Huang, H., Kaber, D. B., Ruiz, J., and Zahabi, M.. Cognitive workload classification of upper-limb prosthetic devices, *2022 IEEE 3rd International Conference on Human-Machine Systems (ICHMS)*, 2022, pp. 1-6.
- C5. Cauffman, S.J., Deng, Y., **Liu, Y.**, Cunningham, C., Kaber, D. B. and Feng, J. Driver logo sign detection and hazard responses during partially automated driving. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*. 2020; 64(1):1960-1964.
- C6. Park, J., Music, A., Daniel, D., Berman, J., Dodson, A., **Liu, Y.**, Ruiz, J., Huang, H., Kaber, D. B., and Zahabi, M.. Cognitive workload and usability of virtual reality simulation for prosthesis training, *2023 IEEE International Conference on Systems, Man, and Cybernetics* (Submitted: 04/11/23).

#### Refereed Research Reports (published)

- R1. Cunningham, C. M., Chase, R. T., Pyo, K., Kaber, D., & **Liu, Y.** (2022). "Roadway signing and marking of unconventional grade separated intersection designs." Project Report. *[North Carolina Department of Transportation (NC DOT)]*.
- R2. Cunningham, C. M., Chase, R. T., Yang, G., Wright, W., Pyo, K., Kaber, D., & **Liu, Y.** (in process). "Design consistency on corridors" Project Report. *[NC DOT]*.

## PRESENTATIONS

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#### Conference Presentations

1. Machine learning models of erroneous driver actions at novel interchange configurations. *IEEE 3rd ICHMS (November 2022)*, Orlando, FL.
2. Driver situation awareness and cognitive workload effects of novel interchange configurations and associated signage. *13th International Conference on AHFE (July 2022)*, New York, NY.
3. User equilibrium model considering traveler decision inertia under random demand network. *Behavioral Operations Management 13th Annual Meeting (2018)*, Guangzhou, China.

#### Poster Presentations

4. Roadway signing and marking of unconventional grade separated intersection designs. *NC DOT 4th Annual Research & Innovation Summit (March 2023)*, Raleigh, NC.
5. Design consistency on corridors. *NC DOT 4th Annual Research & Innovation Summit (March 2023)*, Raleigh, NC.

## SELECTED HONORS AND AWARDS

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| • <b>Linda Parker Hudson Graduate Fellowship Award (\$2,500)</b> , University of Florida | 2023             |
| • <b>Certificates of Outstanding Achievement</b> , University of Florida                 | 2022             |
| • <b>Harold D. Haldeman, Jr. Fellowship Award (\$2,000)</b> , University of Florida      | 2022             |
| • <b>Academic Scholarship (\$1,200)</b> , Nanjing University                             | 2016, 2017, 2018 |
| • <b>Excellent Student Fellowship</b> , Shandong University                              | 2013, 2014, 2015 |
| • <b>Best Undergraduate Thesis</b> , Shandong University                                 | 2016             |
| • <b>The Most Outstanding Student at Shandong University</b> , Shandong University       | 2015             |

## RESEARCH EXPERIENCE

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### Graduate Research Assistant, University of Florida

#### 1. Research on Automation Rate and Situation Awareness Responses (Dissertation) 2019 – Present

- Pioneered the development of a new "automation rate" model to quantify the level of automation in human-in-the-loop systems.
- Designed and implemented a comprehensive algorithm for automation rate calculation, providing a reliable and practical solution.
- Conducted a detailed case study analysis to validate the feasibility and practicality of the automation rate model.
- Established a novel relationship between the automation rate and operator situation awareness response through quantitative modeling.
- Designed and executed a driving simulator experiment to gather empirical data and verify the relationship between the automation rate and human performance responses.
- Processed and analyzed data using advanced statistical methods, including descriptive and inferential statistics, to derive meaningful insights.
- Led the writing of one journal paper and one conference proceeding papers draft.

**Skills and Keywords:** *Automation rate, quantitative modeling, human performance responses, driving simulator, experiment design, case study analysis, data collection, data analysis, descriptive and inferential statistics, Python and R Studio programming.*

#### 2. Roadway Signage for Novel Grade-separated Interchanges (NC DOT Project) 2019-2022

- Designed and implemented situation awareness queries to collect data on driver behavior and performance at different interchanges and signage configurations.
- Designed and executed a human factors experiment to investigate the effects of innovative interchange geometry and traffic control device design on driver visual behavior and performance.
- Processed and analyzed experimental data using Python and R Studio, demonstrating data analysis skills and expertise in statistical methods, including descriptive and inferential statistics.
- Led the development of machine learning models to predict erroneous driver actions based on driver status.
- Drafted the final report for the project, presenting the findings and conclusions.
- Led the writing of one journal paper and two conference proceeding papers draft.

**Skills and Keywords:** *Situation awareness, Qualtrics surveys, human factors experiment design, data analysis, statistical analysis, machine learning, report writing, Python and R Studio programming.*

#### 3. EMG-based Assistive Human-Machine Interface Design (NSF Project) 2020-Present

- Designed and implemented a human factors experiment to study the effects of powered-prosthetic design and control modes on user performance of activities of daily living (ADLs) tasks.
- Conducted hierarchical task analysis, developed a human performance model using Cogulator.
- Processed and analyzed experimental data using Python and R Studio, demonstrating data analysis skills and expertise in statistical methods, including descriptive and inferential statistics.
- Developed the Phase 2 experiment to demonstrate the fundamental motor skill training through the integration of the EMG-based HMI with virtual reality.
- Led the selection of EMG sensor locations, measurement of maximal voluntary contraction, time lag calculation, and development of MATLAB code for real-time EMG raw signal processing.
- Led the development of the protocol for Phase 2 experiment, including equipment preparation, orientation, training, and testing procedures.

- Led the writing of one journal paper draft.
- Contributed to one journal paper and one conference proceeding paper draft.

**Skills and Keywords:** *Human factors experiment design, hierarchical task analysis, human performance modeling, data analysis, statistical analysis, EMG signal processing, protocol development, technical writing for journal and conference proceedings, MATLAB, Python and R Studio programming.*

#### **4. Real-time Perceptually-enabled Task Guidance in the Extremes (DARPA Project) 2022-Present**

- Identified appropriate signal types and acquisition devices for achieving the project's goals through a comprehensive literature review.
- Led the feature extraction process and extracted 11 features from eye-tracker and Empatica E4 devices.
- Led the construction of three machine learning classification models to predict high cognitive load in extreme situations, based on real-time physiological signals from users.
- Conducted hierarchical task analysis and developed a human performance model using Cogulator.
- Led the development of the protocol for the machine learning model training experiment, including equipment preparation, orientation, training, and testing procedures.

**Skills and Keywords:** *Feature extraction, machine learning, hierarchical task analysis, human performance modeling, protocol development.*

#### **5. Other Involved Projects 2019-Present**

- Systems safety analysis research
- Unmanned aerial vehicle interface design
- Consistency in the design of interchanges in high-density traffic corridors
- Non-safety-related in-vehicle and on-road message displays

### **Graduate Student, Nanjing University**

#### **6. User Equilibrium in Stochastic Networks Considering Route Choice Inertia 2016–2019**

- Defined the generalized travel time from two dimensions (length and uncertainty), and reliability coefficient represented the travelers' risk preference.
- Proposed a route choice model with context-dependent preference and compared it with the existing model from theoretical and numerical aspects to validate and ensure the model's compatibility.
- Developed a user equilibrium model under stochastic traffic network, analyzed the equilibrium conditions, and formulated the equivalent nonlinear complement problem.
- Analyzed the nature of the solution through numerical examples.

**Skills and Keywords:** *Route choice modeling, equilibrium analysis, nonlinear complement problem formulation, numerical analysis.*

## **TEACHING EXPERIENCE**

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### **Graduate Teaching Assistant, University of Florida**

- Systems Management (Graduate level), Department of Industrial & Systems Engineering, Summer 2022
- Systems Management (Graduate level), Department of Industrial & Systems Engineering, Summer 2021

### **Graduate Teaching Assistant, Nanjing University**

- Multivariate Statistics and Data Analysis (Graduate level), Department of Management Science & Engineering, Fall 2017

### **Guest Lecture, University of Florida**

- Economic Evaluation (Graduate level), Department of Industrial & Systems Engineering, Summer 2022

- Midterm & Final Exam Review (Graduate level), Department of Industrial & Systems Engineering, Summer 2022

## MENTORING EXPERIENCE

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- Music, C., Graduate Research Assistant, CISE (8/2020 - 8/2022).
- Grimaldi, N., Ph.D. Research Assistant, ISE (3/2022 - present).
- Pfaffenbichler, R., Graduate Research Assistant, ISE (8/2022 - present).
- Xia, S., Undergraduate Research Assistant, ISE (3/2022 - 12/2022).
- Chen, E., Undergraduate Research Assistant, CISE (8/2022 - present).

## TEACHING INTERESTS

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### Undergraduate Level:

- Introduction to Human Factors
- Occupational Safety

### Graduate Level:

- System Design
- System Safety
- System Management
- User Experience Design
- Human Factors in System Design
- Applied Probability Methods in Engineering
- Applied Non-parametric Method in Engineering

## PROFESSIONAL AFFILIATION

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- **Student Member, Human Factors and Ergonomics Society (HFES)**
- **Student Member, Institute of Electrical and Electronics Engineers (IEEE)**

## ACTIVITIES AND SERVICES

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- **Launched and served as the inaugural Student President of the University of Florida's HFES Student Chapter.**  
*Demonstrating exceptional leadership and organizational skills.*
- **Served as Chair and organizer of sessions on Technical Sessions and Student Paper Session for the 3<sup>rd</sup> ICHMS in Orlando, FL, an international conference dedicated to human factors and system design research.**  
*Demonstrating expertise in conference organization and leadership.*
- **Led the student session chairs and staff team for the 3<sup>rd</sup> ICHMS in Orlando, FL, an international conference dedicated to human factors and system design research.**  
*Highlighting strong leadership and teamwork skills.*
- **Acted as a member of the Search Committee for Dean of the prestigious Herbert Wertheim College of Engineering at the University of Florida.**  
*Showcasing ability to contribute to important decision-making processes.*

- Served as a reviewer for prestigious publications and conferences such as *IEEE Transactions on Human-Machine Systems, Human Factors, Cognition, Technology & Work, and IEEE ICHMS 2022*. Demonstrating expertise and knowledge in the field of human factors research.

## SKILLS

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- **Programming Languages:** Python, R, MATLAB
- **Prototype & Design Tools:** UC-winRoad, Qualtrics, LaTeX, Invision
- **Analysis Tools:** SPSS, JMP, Cogulator
- **Equipment:** Driving Simulator (FORUM8 Co. Ltd), Electromyography System (Delsys), Eyetracker (PupilLabs), E4 Wristband (Empatica)
- **Language:** Chinese (Native), English