

# YUNMEI LIU

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## EDUCATION

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

2019 – June, 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 applying the theories and principles of Human Factors and Systems Engineering to the design, analysis, and modeling of human-in-the-loop systems. My research involves the intersection of human factors and ergonomics, transportation engineering, statistics, and computer science, and can be categorized into the following areas:

#### **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, thereby 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, and on this basis, apply 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. (in process). 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 (under review/revision)

2. **Liu, Y.** & Kaber, D. B. (in 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).
3. Lau, M., **Liu, Y.** & Kaber, D. B. (in review). A consequence severity-probability importance measure for fault tree analysis. Submitted to *IEEE Transactions on Reliability Engineering* (9/24/21).
4. Zhang, W., **Liu, Y.** & Kaber, D.B. (in 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)

5. Park, J., Berman, J., Dodson, A., **Liu, Y.**, Armstrong, M., Huang, H., Kaber, D. B., Ruiz, J., and Zahabi, M. (Sep. 2022). Cognitive workload classification of electromyography (EMG)-based prosthetic devices. About to submit to *Ergonomics*.
6. **Liu, Y.**, Park, J., Berman, J., Dodson, A., Huang, H., Kaber, D. B., Ruiz, J., and Zahabi, M. (Sep. 2022). Cognitive workload classification of electromyography (EMG)-based prosthetic devices. About to submitted to *IEEE Transactions on Human-Machine Systems*.
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*.

### Refereed Conference Papers (published in proceeding)

- C1. **Liu, Y.**, Kaber, D. B., Sabahi, S., and Cunningham, C. (2022; under review). Machine learning models of erroneous driver actions at novel interchange configurations, *2022 IEEE 3rd International Conference on Human-Machine Systems (ICHMS)*, 2022, pp. XX-XX.
- C2. Park, J., Berman, J., Dodson, A., **Liu, Y.**, Matthew, A., Huang, H., Kaber, D. B., Ruiz, J., and Zahabi, M. (2022; under review). Cognitive workload classification of upper-limb prosthetic devices, *2022 IEEE 3rd International Conference on Human-Machine Systems (ICHMS)*, 2022, pp. XX-XX.
- C3. **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.
- C4. **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.

- 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.

## SELECTED HONORS AND AWARDS

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| • <b>Harold D. Haldeman, Jr. Fellowship Award</b> , University of Florida          | 2022             |
| • <b>Academic Scholarship</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
  - Defined a new “automation rate” model to quantify the level of automation in systems.
  - Developed an automation rate calculation algorithm.
  - Verified the practicality and feasibility of proposed automation rate model through a case study analysis.
  - Proposed a new relationship between the automation rate and operator situation awareness response.
  - Demonstrated the rationality of proposed relationship model through case analysis and mathematical proof.
  - Designed an experiment to verify the relationship between AR and SA response at 3 different SAE levels under simulated driving scenarios.
2. **Roadway Signage for Novel Grade-separated Interchanges (NC DOT Project)** 2019-2022
  - Designed situation awareness queries to collect the situation awareness data of subjects at different interchanges and different signage configurations.
  - Programmed Qualtrics surveys to render it in the desired format and convert output to spreadsheet file formats.
  - Designed and conducted human factors experiment on effects of grade-separated interchange geometry and traffic control device design on driver visual behavior and performance.
  - Post-processing and analysis of experimental data on subjects' situational awareness, mental load, driving performance, and eye trackers were performed using Python. In addition, descriptive and inferential statistical analyses were conducted on all these responses.
  - Constructed four machine learning classification models to analyze and predict erroneous driver actions at novel interchange configurations given driver's status.
  - Led the drafting of final report for this project.
3. **EMG-based Assistive Human-Machine Interface Design (NSF Project)** 2020-Present
  - Designed human factors experiment on effects of powered-prosthetic design and control modes on user performance of activities of daily living (ADLs) tasks.
  - Conducted hierarchical task analysis based on user performance.
  - Developed human performance model (Cognitive-Perceptual-Motor GOMS) using Cogulator.
  - Post-processing and analysis of experimental data on subject's behaviors, eye-tracker, device usability and cognitive models were performed using Python. In addition, a wide variety of descriptive and inferential statistical analysis methods were applied to all these responses.
  - Designed a VR-based simulation experiment to study the influence of different types of prostheses algorithms on the operating efficiency of subjects.

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

- Identify the various signal types and their acquisition devices that can achieve the project goals.
- Constructed three machine learning classification models to predict user's high cognitive workload in extreme situations, given the user's real-time physiological signals.
- Conducted hierarchical task analysis based on user performance.
- Developed human performance model (Cognitive-Perceptual-Motor GOMS) using Cogulator.

**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, compared the new model with the existing model from theoretical and numerical aspect and obtained the validity and compatibility of the model.
- Put forth a user equilibrium model under stochastic traffic network, provided the analysis of the equilibrium conditions, and gave the formulation of the equivalent nonlinear complement problem. Analyzed the nature of the solution through numerical examples.

## 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

## 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
- Human Performance Modeling
- Applied Probability Methods in Engineering
- Applied Non-parametric Method in Engineering

## PRESENTATIONS

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

## PROFESSIONAL AFFILIATION

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

## ACTIVITIES AND LEADERSHIP

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- **Member of Search Committee for Dean, Herbert Wertheim College of Engineering**, University of Florida
- **1<sup>st</sup> President of UF HFES Student Chapter**, University of Florida
- **Safety Monitor for Human-Systems Engineering Laboratory**, University of Florida
- **Reviewer for:**
  - ♦ *IEEE Transactions on Human-Machine Systems*
  - ♦ *IEEE ICHMS 2022*

## 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