

YUNMEI LIU

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EDUCATION

Ph.D. in Industrial & Systems Engineering

2019 – 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 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

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

Refereed Journal Papers or Book Chapter (accepted or published)

1. Kaber, D., **Liu, Y.** and Lau, M. (Oct. 2021). Considering safety-critical system outcomes in high-dimensional decision spaces with sparse input data: an extension of fault-tree analysis. Book Chapter of *Safety in the Digital Age*, to appear.

Refereed Journal Papers (under review/revision)

2. **Liu, Y.** and Kaber, D. (Dec. 2021). Models of automation rate in human-in-the-loop systems and operator situation awareness responses. Submitted to *IEEE Transactions on Human-Machine Systems*, in revision for 1st review.
3. Park, J., Berman, J., Dodson, A., **Liu, Y.**, Armstrong, M., Huang, H., Kaber, D., Ruiz, J., and Zahabi, M. (Aug. 2022). Cognitive workload classification of electromyography (EMG)-based prosthetic devices. Submitted to *Ergonomics*, in 1st review.
4. **Liu, Y.**, Park, J., Berman, J., Dodson, A., Huang, H., Kaber, D., Ruiz, J., and Zahabi, M. (Aug. 2022). Cognitive workload classification of electromyography (EMG)-based prosthetic devices. Submitted to *Ergonomics*, in 1st review.
5. Lau, M., **Liu, Y.** and Kaber, D. A consequence severity-probability importance measure for fault tree analysis. Target journal: *Reliability Engineering & System Safety*.
6. Zhang, W., **Liu, Y.** and Kaber, D. Effect of Interface Design on Cognitive Workload in Unmanned Aerial Vehicle Control (Aug. 2022). Target journal: *International Journal of Science and Research*

Refereed Journal Papers (in preparation)

7. **Liu, Y.**, Pyo, K., Cunningham, C., Chase, T. Kaber, D. Novel interchange configurations and associated signage assessment. Target journal: *Applied Ergonomics*.
8. **Liu, Y.**, Yang, G., Pyo, K., Xia, S., Cunningham, C., Chase, T. Kaber, D. Design consistency. Target journal: *Applied Ergonomics*.

Refereed Conference Papers (published in proceeding)

- C1. **Liu, Y.**, Kaber, D., Sabahi, S., and Cunningham, C. (2022; in press). 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., Ruiz, J., and Zahabi, M. (2022; in press). Cognitive workload classification of electromyography (EMG)-based 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. 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. 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. 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

- **Harold D. Haldeman, Jr. Fellowship Award**, University of Florida 2022
- **Academic Scholarship**, Nanjing University 2016, 2017, 2018
- **Excellent Student Fellowship**, Shandong University 2013, 2014, 2015
- **Best Undergraduate Thesis**, Shandong University 2016
- **The Most Outstanding Student at Shandong University**, Shandong University 2015

RESEARCH EXPERIENCE

Graduate Research Assistant, University of Florida 2019 – Present

1. **Research on Automation Rate and Situation Awareness Responses (Doctoral Dissertation Project)**
 - 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. **Grade Separated Intersections Signing and Marking (DOT Project)**
 - 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)**
 - 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. Enabling Knowledgeable Task Guidance in the Extremes (DARPA Project)

- 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.

5. Design Consistency on Corridors (DOT Project)

- Post-processed and analyzed experimental data of subject's driving performance under different types of intersections and background corridor types.
- Drafted the final report for this project.

6. Signage Project (DOT Project)

- Post-processed and analyzed experimental data of subject's driving performance under different types of signage.

Graduate Student, Nanjing University

2016 – 2019

7. User Equilibrium in Stochastic Networks Considering Route Choice Inertia

- 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

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

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

INVITED PRESENTATIONS

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

- **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

- **Search Committee for Dean, Herbert Wertheim College of Engineering**, University of Florida
- **President of 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

- **Programming Languages:** Python, R, MATLAB
- **Prototype & Design Tools:** UC-winRoad, Qualtrics, Visio, 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