YUNMEI LIU

Address: 303 Weil Hall, P.O. Box 116595, Gainesville, FL 32611
Mobile: 352-871-3771
Email: liu.yunmei@ufl.edu   **Homepage:** https://yunmeil.github.io/

EDUCATION

Ph.D. in Industrial & Systems Engineering   *2019 – 08/2023 (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

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

Refereed Journal Paper and Book Chapter (accepted or published)

1. Park, J., Berman, J., Dodson, A., **Liu, Y.,** Armstrong, M., Huang, H., Kaber, D. B., Ruiz, J., and Zahabi, M. (2023). Assessing workload in using electromyography (EMG)-based prostheses, *Ergonomics.* https://doi.org/10.1080/00140139.2023.2221413.

2. 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 (under review/revision)

3. **Liu, Y.** & Kaber, D. B. (in 2nd review). Models of automation rate in human-in-the-loop systems and operator situation awareness responses. Submitted to *Institute of Electrical and Electronics Engineers (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 2nd 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 2nd 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 1st 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.,** Kaber, D., Cunningham, C., Chase, T., and Pyo, K. (about to submit) Analysis of driver behavior at grade-separated intersections to support design. 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.. Validity assessment for a SA response function in level of automation. Target journal: *Human Factors.*

10. **Liu, Y.** and Kaber, D.. 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.. 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., Sabahi, S., Cunningham, C, and Pyo, K. (2022). Machine learning models of erroneous driver actions at novel interchange configurations. *IEEE International Conference on Human-Machine Systems*, pp. 1-6. https://ieeexplore.ieee.org/document/9980657

C2. **Liu, Y.,** Pyo, K., Cunningham, C., Chase, T. and Kaber, D. (2022). Driver situation awareness and cognitive workload effects of novel interchange configurations and associated signage. *International*

Conference on Applied Human Factors and Ergonomics, Vol. 60: 287-296. https://openaccess.cms-conferences.org/publications/book/978-1-958651-36-0/article/978-1-958651-36-0_32

C3. **Liu, Y.** and Kaber, D. (2021). Quantitative models for automation rate and situation awareness response: A case study of levels of driving automation. *IEEE International Conference on Human-Machine Systems*, pp. 1-6. https://ieeexplore.ieee.org/document/9582630

C4. Park, J., Berman, J., Dodson, A., **Liu, Y.**, Matthew, A., Huang, H., Kaber, D, Ruiz, J., and Zahabi, M. (2022). Cognitive workload classification of upper-limb prosthetic devices. *IEEE International Conference on Human-Machine Systems*, pp. 1-6. https://ieeexplore.ieee.org/document/9980676

C5. Cauffman, S.J., Deng, Y., **Liu, Y.**, Cunningham, C., Kaber, D. and Feng, J. (2020). Driver logo sign detection and hazard responses during partially automated driving. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting.* 64(1):1960-1964. https://journals.sagepub.com/doi/10.1177/1071181320641472

C6. Park, J., Music, A., Daniel, D., Berman, J., Dodson, A., **Liu, Y.**, Ruiz, J., Huang, H., Kaber, D., and Zahabi, M. (2023). Cognitive workload and usability of virtual reality simulation for prosthesis training. *IEEE International Conference on Systems, Man, and Cybernetics.* Accepted.

Refereed Research Reports (published)

R1. Cunningham, C. M., Chase, R. T., Pyo, K., Kaber, D., and **Liu, Y.** (2022). Roadway signing and marking of unconventional grade separated intersection designs. Report No. FHWA/NC/2019-26, *North Carolina Department of Transportation*. Raleigh. https://connect.ncdot.gov/projects/research/RNAProjDocs/RP2019-26%20Final%20Report.pdf

R2. Cunningham, C. M., Chase, R. T., Yang, G., Wright, W., Pyo, K., Kaber, D., and **Liu, Y.** (2023). Design consistency on corridors. Report No. FHWA/NC/2020-31, *North Carolina Department of Transportation*, Raleigh.

PRESENTATIONS

1. **Liu, Y. (Presenter)**, Kaber, D., Sabahi, S., Cunningham, C, and Pyo, K. (2022). Machine learning models of erroneous driver actions at novel interchange configurations. *Oral presentation given at the IEEE 3rd International Conference on Human-Machine Systems,* Orlando, FL. November.

2. **Liu, Y. (Presenter)**, Pyo, K., Cunningham, C., Chase, T. and Kaber, D. (2022). Driver situation awareness and cognitive workload effects of novel interchange configurations and associated signage. *Oral presentation given at the 13th International Conference on Applied Human Factors and Ergonomics,* New York, NY. July.

3. **Liu, Y.** and Kaber, D. (Presenter) (2021). Quantitative models for automation rate and situation awareness response: A case study of levels of driving automation. *Oral presentation given at the IEEE 2nd International Conference on Human-Machine Systems,* Magdeburg, Germany. September.

4. **Liu, Y. (Presenter)**, Pyo, K., Cunningham, C., Chase, T. and Kaber, D. (2023). Roadway signing and marking of unconventional grade separated intersection designs. *Poster presentation given at the North Carolina Department of Transportation 4th Annual Research & Innovation Summit,* Raleigh, NC. March.

5. **Liu, Y. (Presenter)**, Yang, G., Pyo, K., Wright, W. Chase, T. Cunningham, C., and Kaber, D. (2023). Design consistency on corridors. *Poster presentation given at the North Carolina Department of Transportation 4th Annual Research & Innovation Summit, Raleigh*, NC. March.

6. Park, J. (Presenter), Berman, J., Dodson, A., **Liu, Y.**, Matthew, A., Huang, H., Kaber, D, Ruiz, J., and Zahabi, M. (2022). Cognitive workload classification of upper-limb prosthetic devices. *Oral presentation given at the IEEE 3rd International Conference on Human-Machine Systems,* Orlando, FL. November.

7. Cauffman, S.J. (Presenter), Deng, Y., **Liu, Y.**, Cunningham, C., Kaber, D. and Feng, J. (2020). Driver logo sign detection and hazard responses during partially automated driving. *Oral presentation given at the 64th International Annual Meeting of the Human Factors and Ergonomics Society,* Virtual. October.

8. Park, J. (Presenter), Music, A., Daniel, D., Berman, J., Dodson, A., **Liu, Y.**, Ruiz, J., Huang, H., Kaber, D., and Zahabi, M. (2023). Cognitive workload and usability of virtual reality simulation for prosthesis training. *Oral presentation will be given at the IEEE International Conference on Systems, Man, and Cybernetics,* Hawaii, October.

SELECTED HONORS AND AWARDS

- **Linda Parker Hudson Graduate Fellowship Award ($2,500),** University of Florida   *2023*
- **Certificates of Outstanding Achievement,** University of Florida   2022
- **Harold D. Haldeman, Jr. Fellowship Award ($2,000),** University of Florida   *2022*
- **Academic Scholarship ($1,200),** 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

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 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 theatrical 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

Teaching Assistant, University of Florida
- Systems Management (Graduate level)   2023, 2022, 2021

Teaching Assistant, Nanjing University
- Multivariate Statistics and Data Analysis (Graduate level)   2017

Guest Lecture, University of Florida
- Economic Evaluation (Graduate level)   2023, 2022
- Queuing Theory and Analysis (Graduate level)   2023
- Reliability Engineer (Graduate level)   2023
- Human Systems Integration (Graduate level)   2023

LEARDERSHIP AND SERVICES

University-Related Service

- Initiated and served as the inaugural student President, HFES Chapter, University of Florida.

- Led and coordinated student chairs and staff, 3rd International Conference on Human-Machine Systems.

- Participated in the Dean Search Committee, College of Engineering, University of Florida.

Professional Service

- Served as session chair and reviewer, *3rd International Conference on Human-Machine Systems*.

- Acted as reviewer for journals: *IEEE Transactions on Human-Machine Systems, Human Factors, Cognition, Technology & Work*.

MENTORING EXPERIENCE

- Vives, A., Visiting Scholar, French Air & Space Force Academy (1/2023-6/2023).
- Grimaldi, N., Ph.D. Research Assistant, Industrial and Systems Engineering (ISE) Department (3/2022 - present).
- Pfaffenbichler, R., Graduate Research Assistant, ISE Department (8/2022 - present).
- Xia, S., Undergraduate Research Assistant, ISE Department (3/2022 - 12/2022).
- Chen, E., Undergraduate Research Assistant, Computer Science Department (8/2022 - 6/2023).

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
- Applied Probability Methods in Engineering
- Applied Non-parametric Method in Engineering

PRODESSIONAL AFFILIATION

- Student Member, Human Factors and Ergonomics Society

- Student Member, IEEE

SKILLS

- **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