

YUNMEI LIU

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EDUCATION

Ph.D. in Industrial and Systems Engineering

2019 – 12/2023 (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

Human factors, human-automation interaction, quantitative modeling, cognitive modeling, human behavior modeling, wearable technology, data analytics, statistics, machine learning, deep learning

PUBLICATIONS

Refereed Journal Articles

1. **Liu, Y.**, Berman, J., Dodson, A., Park, J., Zahabi, M., Huang, H., Ruiz, J., and Kaber, D. (2022). Human-centered evaluation of EMG-based upper-limb prosthetic control modes. *Institute of Electrical and Electronics Engineers (IEEE) Transactions on Human-Machine Systems*. Minor Revision Submitted (August 2023).
2. Lau, M., **Liu, Y.** and Kaber, D. (2023). A consequence severity-probability importance measure for fault tree analysis. *International Journal of System Assurance Engineering and Management*.
<https://doi.org/10.1007/s13198-023-02162-1>
3. 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>.
4. Kaber, D., **Liu, Y.**, and Lau, M. Y. (2023). Considering severity of safety-critical system outcomes in risk analysis: an extension of fault-tree analysis. In: Le Coze, J.C., Antonsen, S. (eds) *Safety in the Digital Age. SpringerBriefs in Applied Sciences and Technology*. Springer, Cham.
https://doi.org/10.1007/978-3-031-32633-2_6

Refereed Journal Articles (Under Revision)

5. **Liu, Y.** and Kaber, D. (in 2nd review). Models of automation rate in human-in-the-loop systems and operator situation awareness responses. Submitted to *IEEE Transactions on Human-Machine Systems*.
6. **Liu, Y.**, Kaber, D., Cunningham, C., Chase, T., and Pyo, K. (in 2nd review). Analysis of driver behavior at grade-separated intersections to support design. Submitted to *Applied Ergonomics*.
7. Zhang, W., **Liu, Y.** and Kaber, D. (in 2nd review). Effect of interface design on cognitive workload in unmanned aerial vehicle control. Submitted to *International Journal of Human Computer Studies*.

Refereed Journal Articles (In-Preparation)

8. **Liu, Y.**, Delgado, D., Park, J., Music, A., Berman, J., Kaber, D., Ruiz, J., Huang, H., and Zahabi, M.. Virtual Reality (VR) in the early phase design of EMG-based upper-limb prosthetics. Target journal: *Ergonomics*.
9. Park, J., Delgado, D., **Liu, Y.**, Music, A., Berman, J., Kaber, D., Ruiz, J., Huang, H., and Zahabi, M.. A evaluation of EMG-based upper-limb prosthetic control modes: Virtual Reality vs. physical devices. Target journal: *Applied Ergonomics*.
10. **Liu, Y.**, Yang, G., Pyo, K., Cunningham, C., Chase, T., Kaber, D.. Design consistency. Target journal: *Applied Ergonomics*.
11. **Liu, Y.** and Kaber, D.. Validity assessment for a SA response function in level of automation. Target journal: *Human Factors*.
12. **Liu, Y.** and Kaber, D.. Effects of driver experience and level of vehicle automation on SA, workload and performance. Target journal: *Applied Ergonomics*.
13. **Liu, Y.**, Grimaldi, N., Wozniak, D., 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 Proceedings

- 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.

- C7. Chen, Z., Song, Y., **Liu, Y.**, Wu, X.J., and Sebe, N. (2024). Intrinsic Riemannian classifiers on SPD manifolds: a unified framework. *International Conference on Learning Representations (ICLR)*. Under review.
- *Top Conference in Machine Learning*
- C8. Chen, Z., Song, Y., **Liu, Y.**, and Sebe, N. (2024). A Lie Group Approach to Riemannian Normalization for SPD Neural Networks. *ICLR*. Under review.
- *Top Conference in Machine Learning*
- C9. **Liu, Y.**, Grimaldi, N., Basnet, N., Zahabi, M., and Kaber, D. (2024). Classifying cognitive workload using machine learning techniques. Target Conference: *IEEE International Conference on Human-Machine Systems*. To be submitted.
- C10. Grimaldi, N., **Liu, Y.**, McKendrick, R., Ruiz, J., and Kaber, D. (2024). Deep learning forecast of cognitive workload using fNIRS data. Target Conference: *IEEE International Conference on Human-Machine Systems*. To be submitted.

Technical Reports

- 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

- 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.
- 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.
- 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.
- 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 and Innovation Summit*. Raleigh, NC. March.
- 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 and Innovation Summit*. Raleigh, NC. March.
- Liu, Y. (Presenter)** (2023). Quantitative models for system automation rate and operator situation awareness. *Oral presentation given as a 3-minute pitch at the Institute of Industrial and Systems Engineers Doctoral Colloquium*. New Orleans, LA. May.
- 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.

8. 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.
9. 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

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| • Linda Parker Hudson Graduate Fellowship Award (\$2,500) , University of Florida | 2023 |
| • Harold D. Haldeman, Jr. Fellowship Award (\$2,000) , University of Florida | 2022 |
| • Certificates of Outstanding Achievement , University of Florida | 2022 |
| • Academic Scholarship (\$1,200) , Nanjing University | 2016, 2017, 2018 |
| • Excellent Student Fellowship Award , Shandong University | 2013, 2014, 2015 |
| • Outstanding Undergraduate Graduation 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
 - Developed an innovative "automation rate" model to quantify the level of automation in human-in-the-loop systems.
 - Designed and implemented a reliable algorithm for automation rate calculation.
 - Validated the automation rate model's feasibility and practicality through case study analysis.
 - Established a novel relationship between automation rate and operator situation awareness through quantitative modeling.
 - Developed a driving simulator platform for testing SAE level 0, 1, and 4 automations.
 - Conducted a simulator experiment to validate the proposed models, involving advanced data analysis.
 - Led the writing of one journal paper and one conference proceeding papers draft.

Skills and Keywords: *Quantitative modeling, human performance responses, driving simulator, experiment design, case study analysis, data collection, data analytics, statistics, Python and R Studio programming.*

2. **Real-time Perceptually-enabled Task Guidance in the Extremes (DARPA Project)** 2022-Present
 - Led literature review to identify suitable signal types and acquisition devices, aligning with project goals.
 - Directed the feature extraction process, extracting key features from eye-tracker and Empatica E4 devices.
 - Constructed three machine learning models for predicting high cognitive load in extreme situations, utilizing real-time multimodal physiological signals.
 - Overcame challenges related to missing data and feature selection for time-series data.
 - Developed deep learning models to predict users' cognitive workload based on fNIRS data.
 - Conducted hierarchical task analysis and developed a human performance model, alongside leading the protocol for the machine learning model training experiment.
 - Led the writing of one journal paper and one conference proceeding papers draft.

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

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

- Designed and implemented human factors experiment to assess the impact of powered-prosthetic design and control modes on daily life tasks.
- Conducted hierarchical task analysis and developed a human performance model using Cogulator.
- Developed MATLAB code to acquire and smooth the real-time EMG raw signal.
- Developed the protocol for experiment, managing equipment preparation, orientation, and testing procedures.
- Applied data analysis skills to rectify experimental data collection errors.
- Demonstrated data analysis expertise by processing and analyzing experimental data with Python and R Studio.
- Led the writing of two journal papers and contributed to multiple journal and conference proceeding paper drafts.

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

4. Roadway Signage for Novel Grade-Separated Intersections (NC DOT Project) 2019-2022

- Designed and implemented situation awareness queries to collect data on driver behavior and performance at different intersections and signage configurations.
- Designed and executed simulator experiment to investigate the effects of innovative intersection 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 and submitted one journal and two conference proceeding papers.

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

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

Teaching Assistant, University of Florida

- Systems Management (Graduate level) 2023, 2022, 2021

Guest Lecture, University of Florida

- Economic Evaluation (Graduate level) 2023, 2022
- Queuing Theory and Analysis (Graduate level) 2023
- Reliability Engineering (Graduate level) 2023
- Human Systems Integration (Graduate level) 2023

Teaching Assistant, Nanjing University

- Multivariate Statistics and Data Analysis (Graduate level) 2017

LEADERSHIP AND SERVICES

University-Related Service

- Initiated and served as the inaugural student President, HFES Student Chapter. 2022-Present
- Led the team to win the **Bronze Award** in the 2023 HFES Student Chapter recognition.
- 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. 2022

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 and Work*.

MENTORING EXPERIENCE

- Vives, A., Visiting Scholar, French Air and 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 - 6/2023).
- 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/Graduate Level:

- Introduction to Human Factors
- Occupational Safety
- 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

- Student Member, Human Factors and Ergonomics Society
- Student Member, IEEE

SKILLS

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