(1) Statistical analysis

H. Lee, Y. Murzello, M. Nabipour, and S. Samuel, "Investigation of driver preference for a user-centred design of decision systems in autonomous vehicles, Part I: Preference for binary self-driving modes", Theoretical Issues in Ergonomics Science (2024)

H. Lee, and S. Samuel, "Impact of Aging on Driver Preferences for Self-Driving Modes and Behaviors in Two Traffic Complexities", IEEE Access (2024)

H. Lee, and S. Samuel, "Classification of User Preference for Self-Driving Mode and Behaviors of Autonomous Vehicles", IEEE Transactions on Intelligent Vehicles (2024)

(Under review) **H. Lee.**, O. Lim., S. Samuel., "User Preference for Self-driving Behaviors: Beyond Binary Preference for Self-Driving Usage", User Modeling and User-Adapted Interaction (2025)

Summary

- Data engineering: data processing, interaction term.
- Statistical Analysis (descriptive statistics, logistic regression, t/χ^2/ANOVA/Kruskal-Wallis/correlation/ correspondence, etc.)

(2) ML modeling, LLM fine-tuning, and Transformer-based models

H. Lee, and S. Samuel, "Classification of User Preference for Self-Driving Mode and Behaviors of Autonomous Vehicles", IEEE Transactions on Intelligent Vehicles (2024)

H. Lee., N. Jiang., S. Samuel., "Detection of Error in Static and Dynamic Visual Stimulation via EEG and Eye-tracking Systems", Engineering Applications of Artificial Intelligence (2025)

H. Lee., O. Lim., A. Singh., S. Samuel., "Collision Risk Perception Models Using Physiological and Eye-Tracking Signals", IEEE Access (2025)

H. Lee., O. Lim., S. Samuel., "Adaptive Modeling of User Preferences for Self-Driving Behaviors Using Verbal Interaction and AI", Special Issue: Proceedings of the 69th HFES International Annual Meeting (2025)

S. Srinivasan, A. Singh, **H. Lee**, S. Abdalla, and S. Samuel, "Optimizing Intersection Design: Insights from Older Drivers' Physiological Responses and Gap Acceptance Behavior at Signalized Left Turns", IEEE Access (2024)

A. Singh, Y. Murzello, **H. Lee**, S. Abdalla, and S. Samuel, "Moral decision making: Explainable insights into the role of working memory in autonomous driving." Machine Learning with Applications 18 (2024): 100599.

A. Pradhan, J. He, **H. Lee**, and N. Jiang, "Multi-day Analysis of Wrist Electromyogram based Biometrics for Authentication and Personal Identification", *IEEE Transactions on Biometrics, Behavior, and Identity Science* (2023)

(Under review) **H. Lee** and S. Samuel, "Modeling Approach for Adaptive Workload Level Estimation using Physiological Features", Artificial Intelligence for Transportation (2025)

(Under review) **H. Lee** and S. Samuel, " What the Body Tells the Car: Physiological and EyeTracking Cues for AV Preference Modeling", IEEE Transactions on Intelligent Vehicles (2025)

(Under review) W. Zhu, S. Luo, **H. Lee**, A. Singh, and S. Samuel, "Lightweight and interpretable Transformer-Based Models for Predicting Driving Comfort in Autonomous Vehicles", IEEE Access (2025)
(Under review) (Under Review) A. Singh, S. Samuel, and **H. Lee**, "Effectiveness of Attention-Based Models in Predicting Ethical Decisions in Time-Constrained Situations,", IEEE Transactions on Intelligent Vehicles (2025)

(In preparation) **H. Lee,** A. Singh and S. Samuel, "Persona-Based Analysis of Control Room Design Factors for Small Modular Reactors"

Summary

- Supervised/Unsupervised/Semi-supervised learning models
- Feature engineering/Explainable AI (XAI): data processing (signal processing), interaction term, feature importance-based selection (BorutaSHAP, SHAP, LIME, etc.)
- Hyperparameter optimization: Range setup search (grid search) / automatic search methods (Bayesian-based)
- Fine-tuning LLM (T5 model)

(3) Signal Processing

[1] H. Lee., O. Lim., A. Singh., S. Samuel., "Collision Risk Perception Models Using Physiological and Eye-Tracking Signals", IEEE Access (2025)

[2] H. Lee., N. Jiang., S. Samuel., "Detection of Error in Static and Dynamic Visual Stimulation via EEG and Eye-tracking Systems", Engineering Applications of Artificial Intelligence (2025)

[3] A. Pradhan, J. He, **H. Lee**, and N. Jiang, "Multi-day Analysis of Wrist Electromyogram based Biometrics for Authentication and Personal Identification", *IEEE Transactions on Biometrics, Behavior, and Identity Science* (2023)

[4] (Under review) **H. Lee** and S. Samuel, " What the Body Tells the Car: Physiological and EyeTracking Cues for AV Preference Modeling", IEEE Transactions on Intelligent Vehicles (2025)

Summary

- Signal Processing (non-stationary time-series, non-linear, quasi-periodic, stochastic, multivariate, multi-modal)
- EEG, PPG, GSR, EMG preprocessing
- Re-referencing (Common Average Reference - CAR, Revised CAR developed by H. Lee [3])
- Artifact removal (Independent Component Analysis - ICA, Automated ICA)
- Bandpass decomposition, Frequency Division Technique
- Spike/outlier removal, Smoothing (Interpolation/Hampel filter, Savitzky-Golay filter, etc)

(4) Physics-Informed Neural Network practice

https://github.com/catalysthw/PINN/

Summary

- Physics-Informed Learning: PINNs for ODE/PDE forward & inverse problems (physics-based loss with IC/BC incl.

- Burger's equation (forward/inverse)
- Integro-differential equation,
- ODE: Possion, Euler Bernoulli, system of ODEs etc
- PDE: non-linear eq (e.g., Schrodinger eq.), 2D elasticity, 2D heat, advection-diffusion, etc.
- Boundary conditions: hard boundary, periodic boundary, etc.
- Sub-domain: temporal domain, spatial domain.
- Optimizer setup: simple gradient-based optimizer (SGD, Adam, AdamW, etc), L-BFGS (2-step optimizer setup)
- Transfer/Meta-Learning

(5) Reflexive Analysis

(Under review) **H. Lee,** A. Singh and S. Samuel, "Reflexive Thematic Analysis for intelligent control room design of small modular reactor based on open-ended questions from nuclear plant operators"

(6) Experimental System Design / 3D CAD modeling

H. Lee, and O. Lim, "Rapid Compression Expansion Machine", Korea Patent 1017438150000 (2017) (Patent number: 1020150046832, search the patent number http://eng.kipris.or.kr/enghome/main.jsp)

H. Lee, B. Fisk, and J. Ghandhi, "Combustion System Development for Control: Investigation of Pressure Feedback Potential", Engine Research Center Symposium, June 2017, Madison WI, USA (2017)

E. Baeg, R, Doudlah, R. Swader, **H. Lee**, M. Han, S. Kim, A. Rosenberg, and B. Kim, "MRI compatible, Customizable, and 3D Printed Microdrive for Neuroscience Research", *eNeuro 8.2* (2021)

(Conference) B. Kim, **H. Lee**, H.X. Cham, and A. Rosenberg, "Video tracking module for Real-Time Experimental Control with Graphical User Interface (REC-GUI)", Society of Neuroscience, Poster, Nov 2018, San Diego, USA (2018)

Summary

- Injection algorithm development using LabVIEW FPGA/RT and data acquisition system (skip-firing with pressure feedback)
- 3D CAD design for micro-drive electrode insertion tool
- Simple color-tracking system and data acquisition program using UDP/IP communication
- Position control of a high torque piston by using electromagnetic clutches, servomotor, etc.

(7) Combustion analysis

H. Lee, and O. Lim, "A computational study of DME-Methanol fractions with controlling several factors on HCCI", Journal of Mechanical Science and Technology, Volume 30, Issue 4, 1931-1941 (2016)

H. Lee, B. Fisk, and J. Ghandhi, "Combustion System Development for Control: Investigation of Pressure Feedback Potential", Engine Research Center Symposium, June 2017, Madison WI, USA (2017)

Summary

- Analysis of pressure, heat release, and temperature from engine experiment/simulation
- Chemical reaction analysis using combustion simulation program (CHEMKIN)