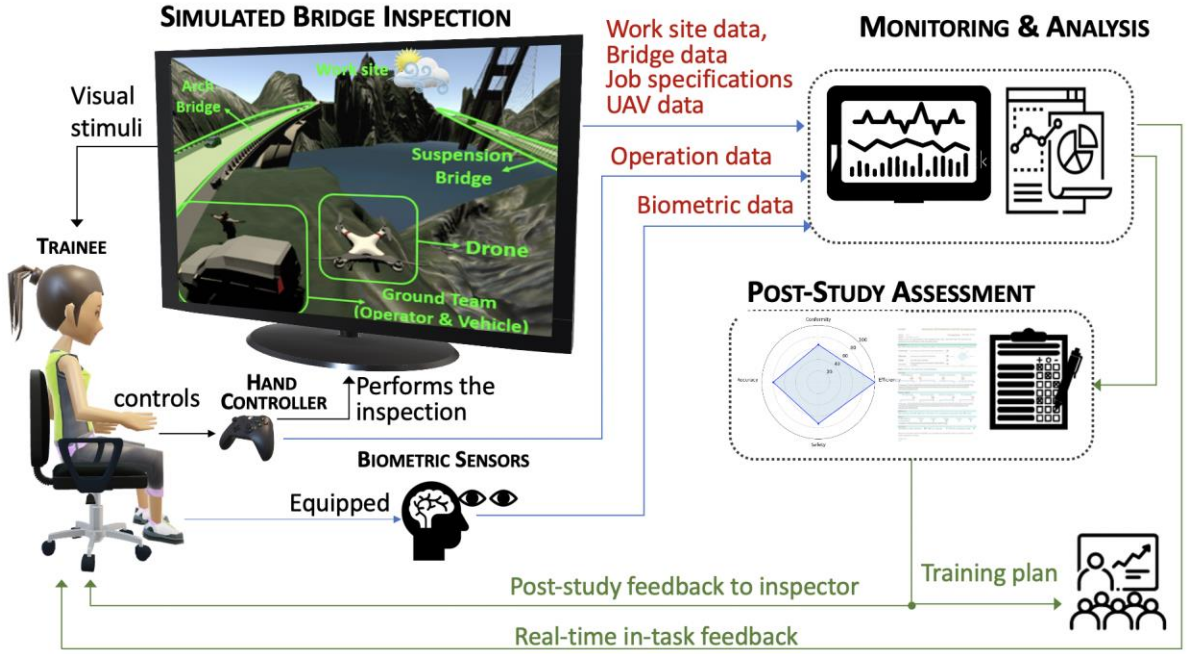
ECCS-2026357/2025929/2026445: Collaborative Research: Assistive Intelligence for Cooperative Robot and Inspector Survey of Infrastructure Systems (AI-CRISIS)
Dr. G.D. Chen, Missouri University of Science and Technology, gchen@mst.edu; Drs. R.W. Qin and Z.Z. Yin, Stony Brook University, zyin@cs.stonybrook.edu;
Dr. D. Nembhard, University of Iowa, david-nembhard@uiowa.edu.

A virtual reality-based bridge inspection individualized training tool, called TASBID, is developed and demonstrated for its ability to identify the training needs of an inspector and help the inspector to develop the required skills and confidence in collaboration with a drone during bridge inspection. The TASBID tool is composed of four key modules:

- SIMULATED BRIDGE INSPECTION developed in Unity to give a trainee an immersive experience as in actual inspection using optical and thermal imaging,
- INTERFACE that allows the trainee to operate the drone and conduct the condition assessment of select bridges in real-time using assistive intelligence from deep learning,
- MONITORING & ANALYSIS that provides real-time, in-task feedback to the trainee to assist his/her learning based on biometric data from EEG sensors and eye tracking,
- POST-STUDY ASSESSMENT to accelerate the learning process of the trainee using attention and engagement models based on both psychological reaction and video segmentation.



Training and Assessment System for Bridge Inspection with a Drone (TASBID): its source code is available on GitHub

1839971: Collaborative Research: Pre-Skilling Workers, Understanding Labor Force Implications and Designing Future Factory Human-Robot Workflows Using a Physical Simulation Platform

PI: Karthik Ramani, Distinguished Prof. ME and ECE Purdue University, ramani@purdue.edu

Goals: 1. Developed physical-reality simulation platform (PRSP), 2. pre-skilling the manufacturing workforce, and 3. understanding and evaluating the labor market implications of augmented Humans (H)-Robots (R) -Machines (M) and AI technologies.

Future Technology

> Mixed reality (MR) to capture interactions + workflows for H+R+M

> In-situ Authoring for IoT-based Machines

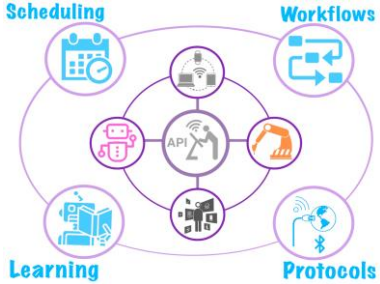
> Humans + MR + AI for easy accessibility

Future Work

> Assessment and metrics in MR: cognitive and learning

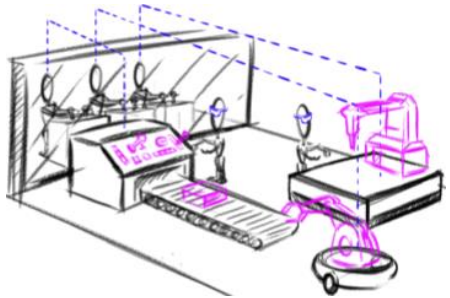
> MR based local-spatial-body coordinated tasks

> Leverage learning theories



Future Workers

> Design and Prototyping Smart Things & Augmenting Human Cognition (Purdue), IoT Course (UCI) 140 + 120 students annually



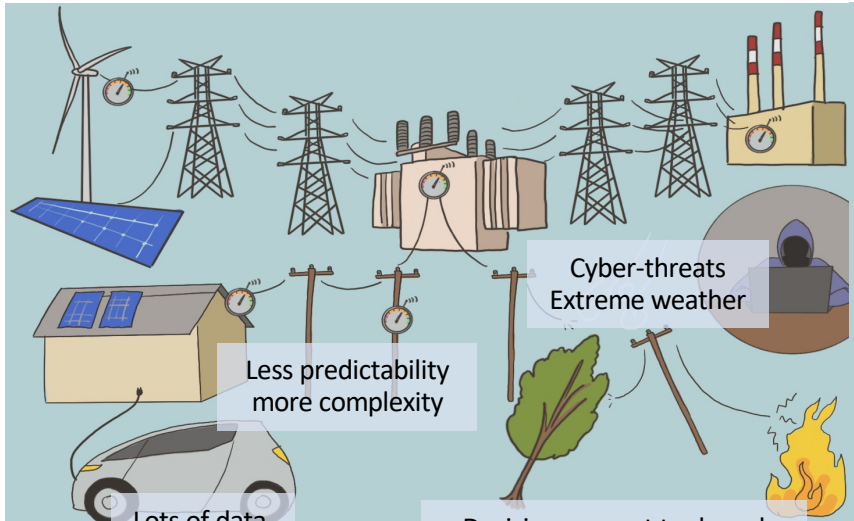
Publications are available at the CONVERGENCE DESIGN LAB website: https://engineering.purdue.edu/cdesign

Award #1840192,0052 & 0083 -FW-HTF: Collaborative Research: Augmenting and Advancing Cognitive Performance of Control Room Operators for Power Grid Resiliency

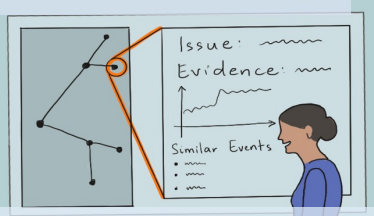
PI(s): Anurag Srivastava, West Virginia University, anurag.srivastava@mail.wvu.edu, Alexandra von Meier, UC Berkeley and Gautam Biswas, Vanderbilt University

A. Srivastava, and S. Sadanandan; West Virginia University.
P. Whitney, S. Lotfifard, and A. Bose; Washington State University
A. von Meier; University of California, Berkeley
G. Biswas and A. Dubey; Vanderbilt University
R. Podmore; IncSys
M. Legatt and J. Obradovich; ResilientGrid
S. Murphy; PingThings
E. Andersen and A. Ashok; Pacific Northwest National Lab
M. Cassiadoro; Total Reliability Solutions
H. Zhang; National Renewable Energy Lab
K. Abdul-Rahman; California ISO
A. Janisko; Snohomish PUD

The key objective of this project is to help power grid operators perform better, especially during extreme adverse events, with advanced monitoring and decision support tools. The project is developing innovative tools by bringing together principles from cognitive neuroscience, data science, machine learning, artificial intelligence, cybersecurity, and power engineering.

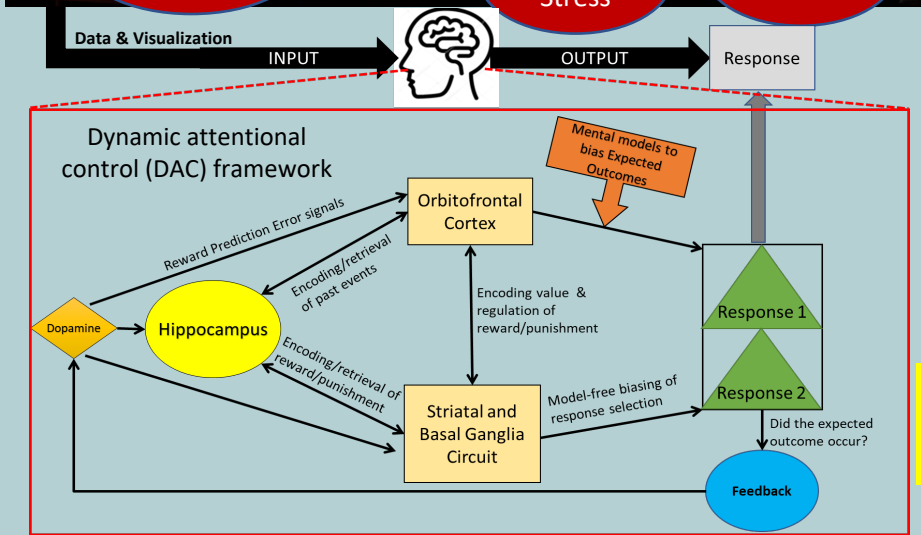


New situations where experience doesn't apply



Modeling and simulation to identify how present situation compares to past

Decision support tools and training for human operators



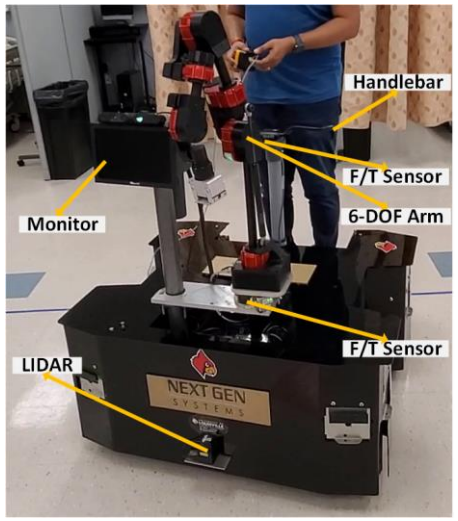
- Validation with students trained as operator
- Validation with real grid operators

Post and pre-training Cognitive Flexibility (CF)
Post and pre-training working memory (WM)
Impact on grid resiliency with training

#202026584, FW-HTF-RM: Enhancing Future Work of Nursing Professionals through Collaborative Human-Robot Interfaces

PI: **Dan Popa,** Louisville Automation and Robotics Research Institute (LARRI), **University of Louisville (UofL),** dan.popa@louisville.edu
Co-PIs: **Olfa Nasraoui,** Dept. of Computer Science and Engineering, **Cindy Logsdon**, School of Nursing, University of Louisville
Bryan Edwards, College of Business, **William Paiva,** Center for Health Sciences and Innovation, **Oklahoma State University**

ARNA
Adaptive Robotic Nursing Assistant



Two archetypical nursing tasks with ARNA

- **Physical assistance to prevent falls.**

A robot is summoned to the patient's bedside, and provides active bracing, ambulation and sitting support to a destination of choice.

- **Patient sitting with object fetching.**

A robot is tasked with fetching objects on demand, taking vital signs, and providing verbal instructions.

Future Workers
= Nurses+Robots

Objective 1: Develop a taxonomy of tasks and skills based on whether they can be justifiably automated with robotics.

Future Technology
=CHRI

Objective 2: Create methodologies through which CHRIs can be designed and evaluated.

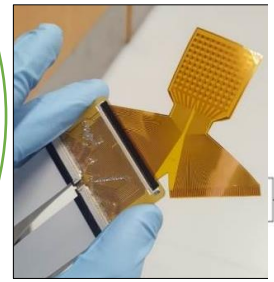
Future Work
= High-Tech Nursing

Objective 3: Evaluate the potential of CHRIs to enhance productivity and reduce nurse stress.

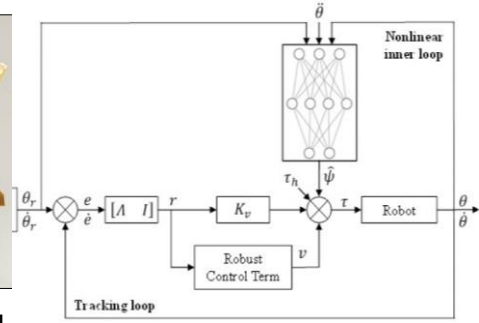
Project
#202026584

Objective 4: Estimate the potential economic impacts of introducing robots for routine nursing tasks.

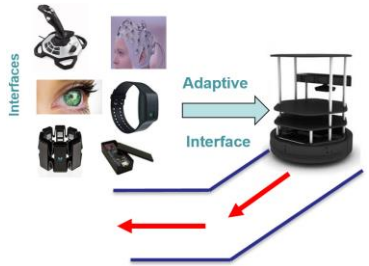
CHRI = Collaborative Human-Robot Interfaces defined as the intelligent connection between multimodal arrays of sensors monitoring human users, and collaborative control decisions and actions taken by robots to assist human users.



Robotic Skin for Physical Human-Robot Interaction



Neuroadaptive Control for Collaborative Robots



Adaptive Interface for Remote Navigation and Manipulation