Integration of Robotics Codes and Standards into the Occupational Safety Engineering Curriculum

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Department of Industrial and Systems Engineering

Module Rationale and Significance

- Although globally robotics technology is growing rapidly, nevertheless, the projected workforce in the US is insufficient to meet future demands for robotic applications in various industries.

- Robotics development is in the national interest and providing training in robotics standard literacy for the next generation is one of the essential components to fostering the skills needed for the robotics industry.

- Students are given few practical tools for designing complex human-robot systems during school.

- The proposed work aims to develop publicly accessible and customizable instructional modules of collaborative robotics and automation safety standardization.

Module Rationale and Significance

■ The proposed work will be conducted primarily at the Department of Industrial & Systems Engineering (ISE) at the University of Florida (UF), while course modules will be sharing with partnering Institutions of Higher Education, non-profit organizations, and industry enterprises through multiple broad dissemination mechanisms.

■ We propose to add the new modules to the undergraduate/master split level course, "Occupational Safety Engineering (EIN6216)" and an upper-level undergraduate "Human Factors Applications (EIN4245)" course.

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Module Rationale and Significance

Strategic Stakeholders	Activities	Outputs	Outcomes & Impacts
Core Team (Robotics safety, Human factors researchers)	**Learning Innovation** — Develop robotics safety standardization modules	At least 30 students are recruited and participate in the revised course module (>80% receive higher than B+)	Students' increased awareness in modern industry robotics standardization process and safety regulation
Industry collaborators	Develop hands on training materials for industry practitioners	Share course module with at least 5 peer institutions, and give pilot guest lectures	Students' increased interested and efficacy in robotics safety standardization
Government agencies	**Evaluation** — UF course evaluation (GatorEvals)	Course modules are made publicly accessible, and broad dissemination efforts are taken (presentation, workshop, etc.)	Bring together the expertise of partners from across the standards and conformity assessment community, and support implementation of the education-related aspects of the effort
UF and local supporting resources	Independent Formative and summative evaluation		

Teaching Modules Design

Lecture Unit	Document Number	Content
1	N/A	Orientation session
2	ISO 10218-1:2011	Robots and robotic devices — Safety requirements for industrial robots — Part 1: Robots
2	ISO 10218-2:2011	Robots and robotic devices — Safety requirements for industrial robots — Part 2: Robot systems and integration
2	ISO/TS 15066:2016	Robots and robotic devices — Collaborative robots
3	ANSI/RIA R15.08-1-2020	Industrial mobile robots - safety requirements - Part 1: Requirements for the industrial mobile robot
4	N/A	Domain expert guest lecture series

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Human Factors Applications

- Undergraduate course introducing industrial engineering students to human factors design and evaluation methods, techniques, and concepts used across different application areas.

- Current domains of application:

  - User experience

  - Healthcare

  - Traffic safety and transportation

  - Human-automation and human-robot interaction

Human Factors Applications

- Domain Knowledge:

  - Terminology

  - Values and goals

  - Methods and best practices

  - Work domain (underlying system constraints, components)

  - Workers and resources

  - Typical processes and tasks

Human-Robot Work Design

- Using Technical Standards to Support Design

  - Introduction to technical standards

  - Standards organizations

  - How to access and read standards

  - Examples of technical standards in HF domains:

    - Healthcare and Medical Device design

    - Surface Transportation

  - Technical Standards in Human-Robot Interaction

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Teaching Module Design

Lecture Unit	Document Number	Content
1	ISO 10218-1:2011, ISO 10218-2:2011, ISO/TS 15066:2016, ANSI/RIA R15.08-1-2020	Domain Topic: Safety Standards for Industrial Human-Robot Interaction
2		Guest Speaker: IBM – Robotics in Manufacturing
3		Guest Speaker: LPRC – Mobile Robotics in Business Settings
4		Case Study Presentation

Case Study Project

Major Goals:

- Task analysis and function allocation of the system

- Application of standards in work process design

Domain area examples:

- Human-robot collaboration in a commercial kitchen

- Human-AI collaboration in art

- Human-automation interaction for a bus driver

Communication Plan

- Broaden dissemination to enhance robotics standardization development

  - UF EDGE (Electronic Delivery of Gator Education) program and other pedagogical resources (recording studios and video editing support, for example) will be leveraged.

  - Social media networking accounts will be created for the project on sites such as LinkedIn, Twitter, and Facebook to publicize the outcomes.

- Outreach, workshops and organized Sessions

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Communication Plan

Institute	Point of Contact	Course Title
U. at Buffalo	Dr. Minghui Zheng	MAE 340 Dynamic Systems
U. at Buffalo	Dr. Winnie Chen	IE 535 – Human Centered Design for Interactive Systems
West Virginia U.	Dr. Yu Gu	MAE 493G / CPE 493M Mobile Robotics
North Carolina State U.	Dr. Xu Xu	ISE352 Fundamentals of Human-Machine Systems Design
Penn State U.	Dr. Matthew Rhudy	EMCH 212: Dynamics
U. of Washington	Dr. Sarah Coppola	HCDE 419 Concepts in Human-Computer Interaction
U. of Toronto	Dr. Birsen Donmez	MIE345 Case Studies in Human Factors and Ergonomics