Minitrack: Human-Robot Interaction and Collaboration (HRIC)

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Abstract

This minitrack explores the forefront of Human-Robot Interaction (HRI), with a focus on the ongoing evolution toward seamless Human-Robot Collaboration (HRC). By addressing the latest breakthroughs in methodologies, technologies, and research, this minitrack aims to shed light on the dynamic and rapidly evolving relationship between humans and robots. Experts will present state-of-the-art advancements that are driving this transformation, fostering deeper integration and cooperation between humans and robotic systems.

Keywords: Human-Robot Interaction (HRI), Human-Robot Collaboration (HRC), advanced robotics, dynamic systems, cooperative robotics

1. Introduction

Welcome to the Minitrack on uman-Robot Interaction and Collaboration (HRIC) at the Hawaii International Conference on System Sciences (HICSS), which is a part of the Collaboration Systems and Technologies track.

Humans are inherently social beings who communicate through multi-modal means spanning audio, visual and physical forms. This social nature heavily impacts how people work together in a team of equals to collaborate on a shared goal, and the effectiveness of their combined efforts in reaching their goal. Robots intended for collaborative work with humans embody physical systems that share a space with their human counterparts. It is no surprise that the nature of how humans work collaboratively with other humans, has a heavy influence on how humans collaborate with embodied robots, using similar forms of multi-modal (audio, visual and physical) communication.

Therefore, the design of multi-modal human-machine interfaces is critical to the successful design of a collaborative robot. The ultimate pursuit being a robot that is accepted by its human collaborators and acts as an equal member of a mixed human/robot team in pursuit of a shared goal.

This minitrack aims at exploring the cutting edge of Human-Robot Interaction (HRI) and the evolution towards seamless Human-Robot Collaboration (HRC). This will make it possible to delve into the forefront of research, where experts unveil the latest findings, methodologies, and technological advancements shaping the dynamic relationship between humans and robots.

This minitrack aims at offering a comprehensive journey through the intricacies of HRI, examining how multi-modal communication, including audio, visual, and physical interactions, plays a pivotal role in fostering meaningful connections. The goal is to provide insights into the innovative design of collaborative robots that coexist harmoniously with humans, sharing spaces and objectives. This minitrack may function as a gateway to the forefront of research, providing a platform for collaboration, knowledge exchange, and inspiration as we navigate the exciting frontier of human-robot collaboration.

Topics of interest include, but are not limited to, the following:

- Promoting cooperative and collaborative interaction with robots
- Examining uncooperative and adversarial human interactions with robots
- The role of adoption and appropriation in

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human–robot interactions

- Empirical studies examining the cognitive, psychological, emotional, and social aspects of human–robot interactions
- The impact of haptic feedback and touch on human–robot interaction
- The role of robot attractiveness on human–robot interaction
- Ethics on human–robot interactions
- Social-emotional models of human–robot interaction
- Theoretical frameworks for human–robot interaction
- Case studies of human–robot interaction
- Design implications for robot interactions at home, work and public spaces
- Human-oriented practices that promote human–robot interactions
- New methodological approaches to studying human–robot interactions
- The role of individual differences (robot and/or human) in human–robot interactions.

Through this minitrack, we hope to promote dialogue, exchange cutting-edge research, and create collaboration among academics, professionals, and decision-makers engaged in robotics and emergency response. We anticipate a lively and insightful conversation on these important issues.

2. Papers in the minitrack

In this minitrack, we are thrilled to present the following paper.

Perceptions of Moral Patiency Across Social Robot Morphologies

Authors: Jaime Banks

Abstract: Evidence indicates humans can see robots as moral patients—entities worthy of moral consideration. Although there is evidence that related considerations (e.g., empathy, mentalising) vary across robot shapes, it is not yet understood whether the perception of moral patiency (PMP, a social-moral status ascription) may differ across robot morphologies. This paper reports a content-analytic secondary analysis of elicited stories (N = 1,395 by 465 respondents; Banks, 2021) about how humans may treat social robots morally or immorally across 36 forms of PMP. Results indicate that the presence of PMP is largely non-different across anthropomorphic, zoomorphic, and mechanomorphic robots. The exception is the Liberty-related notion of ceding resources to the robot (most likely for zoomorphic, though likely a matter of distancing oneself from the stimulus spider-shaped robot) and the Liberty-related notion of making robots free-by-design (most likely for anthropomorphic robots, potentially a matter of transferring valued states to a self-similar machine).

Key Contributions: The key contributions of this paper include:

- Investigation of how humans perceive robots as moral patients (PMP), or entities worthy of moral consideration.
- Analysis of the influence of robot morphology (anthropomorphic, zoomorphic, mechanomorphic) on the perception of moral patiency.
- Findings highlight that PMP is largely consistent across different robot forms, with minimal variation based on morphology.

Enhanced Human-Robot Teaming Through Attention Multi Convolutional Neural Network-Based Multi-Modal Sensor Fusion for Hand Gesture Recognition and Orientation Control

Authors: Alf Stian Sundo Gonsholt, Eivind Enea Greca, Mustapha Haddad, Muhammad Hamza Zafar, and Filippo Sanfilippo

Abstract: Our study aims at enhancing Human-Robot Interaction, Collaboration, and Teaming (HRI/C/T) in industrial automation by developing a novel framework for real-time gesture control of a robotic hand. We use an Inertial Measurement Unit (IMU) sensor for precise orientation control of the end effector, and surface Electromyography (sEMG) sensors to detect muscle movements. The sEMG signals are processed by an Attention-based Multi Convolutional Neural Network (A-MCNN) for accurate gesture detection, enabling the robotic hand to mimic these gestures in real-time. Our method achieves notable results for gesture recognition, with the A-MCNN model attaining an accuracy of 97.89%, a precision of 97.49%, a recall of 97.71%, and an F1 score of 97.65%. This integration of IMU and sEMG technologies with advanced neural networks creates a

responsive and intuitive control mechanism, improving safety, usability, and interaction of collaborative robots in shared workspaces. Our approach aims to transition towards Human-Robot Teaming (HRT), significantly advancing the seamless and safe integration of robots in industrial environments, enhancing productivity and collaboration.

Key Contributions: The key contributions of this paper include:

- A novel framework for real-time gesture control of a robotic hand to enhance Human-Robot Interaction, Collaboration, and Teaming (HRI/C/T) in industrial automation.
- Adoption of an Inertial Measurement Unit (IMU) sensor for precise orientation control and surface Electromyography (sEMG) sensors to detect muscle movements.
- sEMG signals with an Attention-based Multi Convolutional Neural Network (A-MCNN) for accurate real-time gesture detection.
- Achievement of high performance metrics for gesture recognition.
- Combination of IMU and sEMG technologies with advanced neural networks to create a responsive and intuitive robotic control system.

Interaction Context is Key: A Meta-Analysis of Experimental Evidence on Interventions against Algorithm Aversion

Authors: Andrea Capogrosso, Theresa Treffers, and Isabell Welpe

Abstract: Algorithm aversion is a barrier to the adoption of advanced technologies, and individuals prefer human judgement over superior algorithmic decisions in certain contexts. Previous literature has looked at various interventions against algorithm aversion, but all studies have been domain specific. Therefore, this study investigates whether experimentally tested interventions are effective across various domains. We conducted a meta-analysis of 32 experimental studies with 89 effect sizes, demonstrating that these aggregated interventions significantly reduce algorithm aversion (overall effect size=0.23). In line with current research, we split the analysis into human, algorithm and context-specific subsamples and find that modifying the interaction environment shows the highest effectiveness (g=0.55) in overcoming algorithm aversion. Future research should test the intervention approaches identified here as most promising, such as providing information about how many other people found the algorithm useful, or simply framing the task in a more objective way to reduce bias against algorithms.

Key Contributions: The key contributions of this paper include:

- Investigation of interventions to reduce algorithm aversion across various domains, addressing the preference for human judgment over superior algorithmic decisions.
- A meta-analysis of 32 experimental studies with 89 effect sizes to evaluate the effectiveness of interventions.
- Demonstration that aggregated interventions significantly reduce algorithm aversion, with an overall effect size of 0.23.

Working with a Service Robot – Case "Kalle" the Robot in Hotel Hanaholmen

Authors: Emmi Turunen, Virpi Tuunainen, Yong Liu

Abstract: This study employs a case study approach and qualitative methods to explore performance outcomes and factors influencing the effectiveness of service robots in room-service delivery. Conducting 22 interviews with employees of Hotel Hanaholmen that experimented with a service robot, we identified key subjective and taskwork outcomes of human-robot collaboration. The study links task-technology fit with performance impacts in human-robot interactions, enhancing the literature on service robots by offering qualitative insights and understanding employee reactions to working with these robots. Practically, it provides valuable insights for integrating service robots, emphasizing feasibility requirements for optimal use.

Key Contributions: The key contributions of this paper include:

- A case study approach and qualitative methods to investigate performance outcomes and factors influencing the effectiveness of service robots in room-service delivery.
- 22 interviews with employees of Hotel Hanaholmen who experimented with a service robot, identifying key subjective and taskwork outcomes of human-robot collaboration.
- Qualitative insights into employee reactions and experiences working with service robots.

How RPA can help employees attain Work-Life Balance

Authors: Abdul Noordeen

Abstract: This study explores how Robotic Process Automation (RPA) enhances life satisfaction (LS) for lower-level employees by automating repetitive tasks in business processes like expense management and customer relationship management. By freeing employees from mundane tasks, RPA allows them to engage in more creative work, potentially improving work-life balance (WLB) and overall well-being. The paper reviews the literature on WLB and RPA perceptions across different demographics, identifying a research gap in how RPA's impact on LS varies with factors like age, gender, and culture. It utilizes Nam's (2014) theory of work-life balance and Shao & Li's (2022) extended adaptive structuration theory, which examines adaptation to technology through the interplay of technology, individual characteristics, and job features. By proposing a conceptual model that links job eustress and perceived workload with LS through RPA, the research aims to offer insights into tailoring RPA implementations to diverse employee demographics to maximize LS leading WLB.

Key Contributions: The key contributions of this paper include:

- Exploring how Robotic Process Automation (RPA) enhances life satisfaction (LS) for lower-level employees by automating repetitive business tasks, such as expense management and customer relationship management.
- Highlighting how RPA allows employees to engage in more creative work, potentially improving work-life balance (WLB) and overall well-being.
- A conceptual model linking job eustress and perceived workload with LS through RPA.