S&T In-Depth

THE LATEST IN SCIENCE AND TECHNOLOGY RESEARCH LITERATURE

FEATURE TOPIC: HUMAN-MACHINE TEAMING

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TECHNICAL ARTICLES

Review Articles

Human-Agent Teaming for Multirobot Control: A Review of Human Factors Issues (USA) 2014

Author(s): Chen, JYC (Chen, Jessie Y. C.); Barnes, MJ (Barnes, Michael J.)

ABSTRACT: The human factors literature on intelligent systems was reviewed in relation to the following: efficient human supervision of multiple robots, appropriate human trust in the automated systems, maintenance of human operator's situation awareness, individual differences in human-agent (H-A) interaction, and retention of human decision authority. A number of approaches-from flexible automation to autonomous agents-were reviewed, and their advantages and disadvantages were discussed. In addition, two key human performance issues (trust and situation awareness) related to H-A teaming for multirobot control and some promising user interface design solutions to address these issues were discussed. Some major individual differences factors (operator spatial ability, attentional control ability, and gaming experience) were identified that may impact H-A teaming in the context of robotics control.

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Times Cited: 12
Number of references: 198
Tags: Review article, Human-Machine systems

Human Interaction With Robot Swarms: A Survey (UK) 2016

Author(s): Kolling, A (Kolling, Andreas); Walker, P (Walker, Phillip); Chakraborty, N (Chakraborty, Nilanjan); Sycara, K (Sycara, Katia); Lewis, M (Lewis, Michael)

ABSTRACT: This paper is the first survey of human-swarm interaction (HSI) and identifies the core concepts needed to design a human-swarm system. We first present the basics of swarm robotics. Then, we introduce HSI from the perspective of a human operator by discussing the cognitive complexity of solving tasks with swarm systems. Next, we introduce the interface between swarm and operator and identify challenges and solutions relating to human-swarm communication, state estimation and visualization, and human control of swarms. For the latter, we develop a taxonomy of control methods that enable operators to control swarms effectively. Finally, we synthesize the results to highlight remaining challenges, unanswered questions, and open problems for HSI, as well as how to address them in future works.

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Times Cited: 0
Number of references: 140
Tags: Review article, Human-Machine Systems

IEEE TRANSACTIONS ON HUMAN-MACHINE SYSTEMS: Year in Review for 2014 (USA) 2014

Author(s): Bass, EJ (Bass, Ellen J.)

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IEEE TRANSACTIONS ON HUMAN-MACHINE SYSTEMS: Year in Review for 2015 (USA) 2015

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Overview of Auditory Representations in Human-Machine Interfaces (Hungary) 2013

Author(s): Csapo, A (Csapo, Adam); Wersenyi, G (Wersenyi, Gyoergy)

ABSTRACT: The successful use of auditory representations in this growing number of application scenarios has in turn prompted researchers to rediscover the more basic auditory representations and extend them in various directions. The goal of this article is to survey both classical auditory representations (e. g., auditory icons and earcons) and those auditory representations that have been created as extensions to earlier approaches, including speech-based sounds (e.g., spearcons and spindex representations), emotionally grounded sounds (e.g., auditory emoticons and spemoticons), and various other sound types used to provide sonifications in practical scenarios. The article concludes by outlining the latest trends in auditory interface design and providing examples of these trends.

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Social Cognitive and Affective Neuroscience in Human-Machine Systems: A Roadmap for Improving Training, Human-Robot Interaction, and Team Performance (USA) 2014

Author(s): Wiltshire, TJ (Wiltshire, Travis J.); Fiore, SM (Fiore, Stephen M.)

ABSTRACT: This paper augments recent advances in social cognitive and affective neuroscience (SCAN) and illustrates their relevance to the development of novel human-machine systems. Advances in this area are crucial for understanding and exploring the social, cognitive, and neural processes that arise during human interactions with complex sociotechnological systems. Overviews of the major areas of SCAN research, including emotion, theory of mind, and joint action, are provided as the basis for describing three applications of SCAN to human-machine systems research and development. Specifically, this paper provides three examples to demonstrate the broad interdisciplinary applicability of SCAN and the ways it can contribute to improving a number of human-machine systems with the pursuit of further research in this vein. These include applying SCAN to learning and training, informing the field of human-robot interaction (HRI), and, finally, for enhancing team performance. The goal is to draw attention to the insights that can be gained by integrating SCAN with ongoing human-machine system research and to provide guidance to foster collaborations of this nature. Toward this end, we provide a systematic set of notional research questions for each detailed application within the context of the three major emphases of SCAN research. In turn, this study serves as a roadmap for preliminary investigations that integrate SCAN and human-machine system research.

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Tags: Review article, Human-Machine Systems

Supervisory Control of Multiple Robots: Human-Performance Issues and User-Interface Design (USA) 2011

Author(s): Chen, JYC (Chen, Jessie Y. C.); Barnes, MJ (Barnes, Michael J.); Harper-Sciarini, M (Harper-Sciarini, Michelle)

ABSTRACT: In the report, we first present an overview of definitions and important terms of supervisory control and human-agent teaming. We then discuss human performance issues in supervisory control of multiple robots with regard to operator multitasking performance, trust in automation, situation awareness, and operator workload. In the following sections, we review research findings for specific areas of supervisory control of multiple ground robots, aerial robots, and heterogeneous robots (using different types of robots in the same mission). In the last section, we review innovative techniques and technologies designed to enhance operator performance and reduce potential performance degradations identified in the literature.

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Tags: Review article, Human-Machine systems

Towards a cognitive approach to human-machine cooperation in dynamic situations (France) 2001

Author(s): Hoc, JH (Hoc, JH)

ABSTRACT: This paper reviews the state of the art on cognitive cooperation to extend an individual cognitive architecture and deal with these situations, combining private and cooperative activities that are highly task-oriented. Cooperation is taken as the management of interference between individual activities to facilitate the team members' sub-tasks and the team's common task when there is one. This review of the literature is a step towards a theoretical approach that could be relevant to evaluate cooperation and to design assistance in diverse domains such as air traffic control or aircraft piloting. (C) 2001 Academic Press.

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Tags: Review article, Human-Machine systems

Trusted Autonomy and Cognitive Cyber Symbiosis: Open Challenges (Australia) 2016

Author(s): Abbass, HA (Abbass, Hussein A.); Petraki, E (Petraki, Eleni); Merrick, K (Merrick, Kathryn); Harvey, J (Harvey, John); Barlow, M (Barlow, Michael)

ABSTRACT: This paper considers two emerging interdisciplinary, but related topics that are likely to create tipping points in advancing the engineering and science areas. Trusted Autonomy (TA) is a field of research that focuses on understanding and designing the interaction space between two entities each of which exhibits a level of autonomy. These entities can be humans, machines, or a mix of the two. Cognitive Cyber Symbiosis (CoCyS) is a cloud that uses humans and machines for decision-making. In CoCyS, human-machine teams are viewed as a network with each node comprising humans (as computational machines) or computers. CoCyS focuses on the architecture and interface of a Trusted Autonomous System. This paper examines these two concepts and seeks to remove ambiguity by introducing formal definitions for these concepts. It then discusses open challenges for TA and CoCyS, that is, whether a team made of humans and machines can work in fluid, seamless harmony.

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Times Cited: 0
Number of references: 77
Tags: Review article, Human-Machine Systems

Human-Machine Systems

Human-Agent Teaming for Multi-Robot Control: A Literature Review (USA) 2013

Author(s): Jessie Y. C. Chen and Michael J. Barnes, Human Research and Engineering Directorate, ARL

Source: Report number ARL-TR-6328, February 2013

ABSTRACT: The literature on intelligent systems was reviewed in relation to the following: efficient human supervision of multiple robots; appropriate human trust in the automated systems; maintenance of human operator's situation awareness; individual differences in human-agent (H-A) interaction; and retention of human decision authority. A number of approaches, from flexible automation to autonomous agents, were reviewed and their advantages and disadvantages were discussed. Also discussed were two key human performance issues (trust and situation awareness) related to H-A teaming for multi-robot control and some promising user interface design solutions to address these issues. Some key individual differences factors (operator spatial ability, attentional control ability, and gaming experience) were identified that may impact H-A teaming in the context of robotics control.

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Number of references: 180
Times cited: 0
Tags: Human-Machine Systems

Assessing Human-Agent Teams for Future Space Missions (the Netherlands) 2010 (Open Acccess)

Author(s): Smets, NJJM (Smets, Nanja J. J. M.); van Diggelen, J (van Diggelen, Jurriaan); Neerincx, MA (Neerincx, Mark A.); Bradshaw, JM (Bradshaw, Jeffrey M.); Jonker, CM (Jonker, Catholijn M.); de Rijk, LJV (de Rijk, Lennard J. V.); Senster, PAM (Senster, Pieter A. M.); ten Thije, O (ten Thije, Ot); Sierhuis, M (Sierhuis, Maarten)

Source: IEEE INTELLIGENT SYSTEMS Volume: 25 Issue: 5 Pages: 46-53 DOI: 10.1109/MIS.2010.105 Published: SEP-OCT 2010

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Times Cited: 1
Number of references: 14
Tags: Human-Machine Systems

Designing dynamic distributed cooperative Human-Machine Systems (Germany) 2012

Author(s): Ludtke, A (Luedtke, A.); Javaux, D (Javaux, D.); Tango, F (Tango, F.); Heers, R (Heers, R.); Bengler, K (Bengler, K.); Ronfle-Nadaud, C (Ronfle-Nadaud, C.)

Source: WORK-A JOURNAL OF PREVENTION ASSESSMENT & REHABILITATION Volume: 41 Pages: 4250-4257 DOI: 10.3233/WOR-2012-0719-4250 Supplement: 1 Published: 2012

ABSTRACT: The paper presents a new approach to the development of cooperative human-machine systems in the Transportation domain which is currently researched in the European project D3CoS. A necessary precondition for the acceptance of cooperative human-machine systems with shared control is the confidence and trust of the user into the system. D3CoS tackles this important issue by addressing the cooperative system as the object and the target of the system development process. This new perspective, along with corresponding innovative methods, techniques and tools, shall allow the identification of optimal task and authority sharing approaches supported by intuitive human-machine interaction and user interfaces at an early stage of system development. This will support powerful teamwork between humans and machines or between machines and machines that is transparent, intuitive and easy to understand. The paper describes the research dimensions for the development of the methods, techniques and tools as well as first results.

continued

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Times Cited: 2

Number of references: 13

Tags: Human-Machine Systems, Applications - industry

Human-Agent-Robot Teamwork (USA) 2012

Author(s): Bradshaw, JM (Bradshaw, Jeffrey M.); Dignum, V (Dignum, Virginia); Jonker, C (Jonker, Catholijn); Sierhuis, M (Sierhuis, Maarten)

Source: IEEE INTELLIGENT SYSTEMS Volume: 27 Issue: 2 Pages: 8-13 Published: MAR-APR 2012 DOI: 10.1109/MIS.2012.37

ABSTRACT: HART research seeks to bring together the best thinking from diverse research communities in order to advance current and anticipated applications of intelligent human-machine collaboration, including the participation of humans as first-class citizens in collaboration with autonomous systems. This would enable autonomous systems not merely to do things for people, but also to work together with people and other systems-the inevitable next leap-forward required in autonomous system design and deployment.

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Times Cited: 5

Number of references: 2

Tags: Human-Machine Systems

Human-agent teamwork in dynamic environments (the Netherlnds) 2012

Author(s): van Wissen, A (van Wissen, A.); Gal, Y (Gal, Y.); Kamphorst, BA (Kamphorst, B. A.); Dignum, MV (Dignum, M. V.)

Source: COMPUTERS IN HUMAN BEHAVIOR Volume: 28 Issue: 1 Pages: 23-33 DOI: 10.1016/j.chb.2011.08.006 Published: JAN 2012

ABSTRACT: This paper presents a behavioral study of fairness and trust in a heterogeneous setting comprising both computer agents and human participants. It investigates people's choice of teammates and their commitment to their teams in a dynamic environment in which actions occur at a fast pace and decisions are made within tightly constrained time frames, under conditions of uncertainty and partial information. Results show that when people form teams, they offer significantly less reward to agents than they offer to people. The most significant factor affecting people's decisions whether to defect from their existing teams is the extent to which they had successful previous interactions with other team members. Also, there is no significant difference in people's rate of defection from agent-led teams as compared to their defection from human-led teams. These results are significant for agent designers and behavioral researchers who study human-agent interactions. (C) 2011 Elsevier Ltd. All rights reserved.

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Times Cited: 12

Number of references: 62

Tags: Human-Machine Systems

Human-robot Team Coordination That Considers Human Fatigue (USA) 2014

Author(s): Zhang, K (Zhang, Kai); Li, XB (Li, Xiaobo)

ABSTRACT: The contribution of this paper is in the introduction of a human fatigue model and the application of this model to a mixed team coordination framework in order to predict team performance given the constraints of human fatigue. The human fatigue model - namely a FAtigue Prediction (FAP) model - is used to conduct numerical simulations that predict mixed team performances. Specifically, extensive simulations are performed to determine how human fatigue influences the choice of the number of agents for a given number of tasks. The novel mixed team coordination framework is a Stochastic Clustering Auction (SCA), which is based on a modification of the Swendsen-Wang method, called SW(2)SCA. It enables complex and efficient movement between clusters by connecting tasks that appear to be synergistic and then stochastically reassigning these connected tasks. In SW(2)SCA, the auctioneer makes stochastic movements with homogeneous or heterogeneous agents. The final discussion outlines a systematic procedure to predict the performance of human-robot systems with the FAP model in SCA.

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Times Cited: 0
Number of references: 24
Tags: Human-Machine Systems

Hybrid human-machine information systems: Challenges and opportunities (England) 2015

Author(s): Demartini, G (Demartini, Gianluca)

ABSTRACT: In this paper we focus on the use of crowdsourcing as core component of data-driven systems. The creation of hybrid human-machine systems is a highly promising direction as it allows leveraging both the scalability of machines over large amounts of data as well as keeping the quality of human intelligence in the loop to finally obtain both efficiency and effectiveness in data processing applications. Such a hybrid approach is a great opportunity to develop systems that are more powerful than purely machine-based ones. For example, it is possible to build systems that can understand sarcasm in text at scale. However, when designing such systems it is critical to take into account a number of dimensions related to human behavior as humans become a component of the overall process.

We overview existing hybrid human-machine systems presenting commonalities in the approaches taken by different research communities. We summarize the key challenges that one has to face in developing such systems as well the opportunities and the open research directions to make such approaches the best way to process data in the future. (c) 2015 Elsevier B.V. All rights reserved.

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Times Cited: 0
Number of references: 67
Tags: Human-Machine Systems

Learning HMM-based cognitive load models for supporting human-agent teamwork (USA) 2010

Author(s): Fan, XC (Fan, Xiaocong); Chen, PC (Chen, Po-Chun); Yen, J (Yen, John)

ABSTRACT: We take the position that in a mixed human-agent team, agents empowered with cognitive load models of human team members can help humans develop better shared mental models to enhance team performance. Inspired by human information processing system, we here propose a HMM-based load model for members of human-agent teams, and investigate the development of realistic cognitive load models. A cognitive experiment was conducted in team contexts to collect data about the observable secondary task performance of human participants. The data were used to train hidden Markov models (HMM) with varied numbers of hypothetical hidden states. The result indicates that the model spaces have a three-layer structure. Statistical analysis

also reveals some characteristics of the models at the top-layer. This study can be used in guiding the selection of HMM-based cognitive load models for agents in human-centered multi-agent systems. (C) 2008 Elsevier B. V. All rights reserved.

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Times Cited: 7
Number of references: 22
Tags: Human-Machine Systems

Learning of compliant human-robot interaction using full-body haptic interface (Slovenia) 2013

Author(s): Peternel, L (Peternel, Luka); Babic, J (Babic, Jan)

ABSTRACT: We present a novel approach where a human demonstrator can intuitively teach robot full-body skills. The aim of this approach is to exploit human sensorimotor ability to learn how to operate a humanoid robot in real time to perform tasks involving interaction with the environment. The human skill is then used to design a controller to autonomously control the robot. To provide the demonstrator with the robot's state suitable for the full-body motion control, we developed a novel method that transforms robot's sensory readings into feedback appropriate for the human. This method was implemented through a haptic interface that was designed to exert forces on the demonstrator's centre of mass corresponding to the state of the robot's centre of mass. To evaluate the feasibility of this approach, we performed an experiment where the human demonstrator taught the robot how to compliantly interact with another human. The results of the experiment showed that the proposed approach allowed the human to intuitively teach the robot how to compliantly interact with a human.

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Times Cited: 1
Number of references: 28
Tags: Human-Machine Systems

On Combining Language Models to Improve a Text-based Human-machine Interface (Brazil) 2015

Author(s): Cavalieri, DC (Cavalieri, Daniel Cruz); Bastos, T (Bastos-Filho, Teodiano); Palazuelos-Cagigas, SE (Elena Palazuelos-Cagigas, Sira); Sarcinelli, M (Sarcinelli-Filho, Mario)

ABSTRACT: This paper concentrates on improving a text-based human-machine interface integrated into a robotic wheelchair. Since word prediction is one of the most common methods used in such systems, the goal of this work is to improve the results using this specific module. For this, an exponential interpolation language model (LM) is considered. First, a model based on partial differential equations is proposed; with the appropriate initial conditions, we are able to design a interpolation language model that merges a word-based n-gram language model and a part-of-speech-based language model. Improvements in keystroke saving (KSS) and perplexity (PP) over the word-based n-gram language model and two other traditional interpolation models are obtained, considering two different task domains and three different languages. The proposed interpolation model also provides additional improvements over the hit rate (HR) parameter.

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Times Cited: 0
Number of references: 54
Tags: Human-Machine Systems

Scheduling robot task performance for a cooperative human and robotic team (USA) 2010

Author(s): Singer, SM (Singer, Sharon M.); Akin, DL (Akin, David L.)

ABSTRACT: Future space missions will benefit from leveraging the unique capabilities of a cooperative human and robot team for performing operational and exploration activities. This research extends the task allocation and scheduling methodology demonstrated in previous research to characterize the effect of the robotic agent's performance of tasks on overall team performance. Analysis of this parameter in future scheduling projects would provide guidance in selecting a robot design that not only satisfies all operational goals but also contributes to the overall cooperative team performance. The schedules developed meet all of the mission constraints while minimizing overall task list completion time and minimizing the wait time between agents. (C) 2009 Elsevier Ltd. All rights reserved.

Author Keywords: EVA; HST servicing; Human-robot interaction; Satellite servicing; Hubble Space Telescope
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Times Cited: 0
Number of references: 14
Tags: Human-Machine Systems

Semantic Based Support for Planning Information Delivery in Human-agent Collaborative Teams (Scotland) 2014

Author(s): Lino, N (Lino, Natasha); Siebra, C (Siebra, Clauirton); Tate, A (Tate, Austin)

ABSTRACT: This work presents a general framework for planning information delivery, which is divided into two main parts: a knowledge representation aspect based on an ontological set and a reasoning mechanism for multimodality visualization. This framework is built on a mixed-initiative planning basis, which considers the additional requirements that the human presence brings to the development of collaborative support systems.

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Times Cited: 0
Number of references: 40
Tags: Human-Machine Systems

Special Issue on Systematic Approaches to Human-Machine Interface: Improving Resilience, Robustness, and Stability (USA) 2016

Author(s): Mercer, E (Mercer, Eric); Rungta, N (Rungta, Neha); Gillan, DJ (Gillan, Douglas J.)

ABSTRACT: The papers in this special section focus on systematic approaches to human-machine interface applications. The motivation for this special issue is the growing increase of remote mission management, unmanned aircraft systems, NextGen operations in the U.S. and its Single European Sky Air Traffic Management Research counterparts in Europe, and other similarly integrated systems of systems that include complex human-machine systems with high levels of autonomy and team dynamics that are difficult to understand and analyze. The issue explores key research areas that impact the properties of these systems, which rely on varied degrees of human and machine interactions. The special issue is a result of the continued interest in the formal verification of complex human-machine systems.

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Times Cited: 0
Number of references: 24
Tags: Human- Machine Syatems

Human-Machine Interface

An Affordance-Based Model of Human Action Selection in a Human-Machine Interaction System with Cognitive Interpretations (South Korea) 2016

Author(s): Ryu, H (Ryu, Hokyoung); Kim, N (Kim, Namhun); Lee, J (Lee, Jangsun); Shin, D (Shin, Dongmin)

ABSTRACT: This article extends the affordance-based finite state automata model, conditioning human prior experience and natural memory decay of task knowledge (or skill decay). The new model draws upon both reinforcement learning and natural memory decay for decision-making on action choice. An empirical study is carried out to specify how action choice is affected or updated by reinforcement learning based on past experience, and Wickelgren's decay function is jointly employed to predict human decision-making behavior.

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Times Cited: 0
Number of references: 52
Tags: Human-Machine interface, Human-Machine systems

Command-based voice teleoperation of a mobile robot via a human-robot interface (Spain) 2015

Author(s): Poncela, A (Poncela, Alberto); Gallardo-Estrella, L (Gallardo-Estrella, Leticia)

ABSTRACT: In this paper, a HRI is presented to teleoperate a robotic platform via the user's voice. Hence, a speech recognition system is necessary. In this work, a user-dependent acoustic model for Spanish speakers has been developed to teleoperate a robot with a set of commands. Experimental results have been successful, both in terms of a high recognition rate and the navigation of the robot under the control of the user's voice.

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Times Cited: 1
Number of references: 46
Tags: Human-Machine interface,Human-Machine Systems

Composition of Constraint, Hypothesis and Error Models to improve interaction in Human-Machine Interfaces (Spain) 2016

Author(s): Navarro-Cerdan, JR (Navarro-Cerdan, J. Ramon); Llobet, R (Llobet, Rafael); Arlandis, J (Arlandis, Joaquim); Perez-Cortes, JC (Perez-Cortes, Juan-Carlos)

ABSTRACT: We use Weighted Finite-State Transducers (WFSTs) to represent the different sources of information available: the initial hypotheses, the possible errors, the constraints imposed by the task (interaction language) and the user input. The fusion of these models to find the most probable output string can be performed efficiently by using carefully selected transducer operations. The proposed system initially suggests an output based on the set of hypotheses, possible errors and Constraint Models. Then, if human intervention is needed, a multimodal approach, where the user input is combined with the aforementioned models, is applied to produce, with a minimum user effort, the desired output. This approach offers the practical advantages of a de-coupled model (e.g. input-system + parameterized rules + post-processor), keeping at the same time the error-recovery power of an integrated approach, where all the steps of the process are performed in the same formal machine (as in a typical HMM in speech recognition) to avoid that an error at a given step remains unrecoverable in the subsequent steps. The experimental results obtained demonstrate that a significant user effort can be saved when using the proposed procedure. A simple demonstration, to better understand and evaluate the proposed system, is available on the web https://demos.iti.upv.es/hi/. (C) 2015 Elsevier B.V. All rights reserved.

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A direct methodology to establish design requirements for human-system interface (HSI) of automatic systems in nuclear power plants (South Korea) 2014

Author(s): Anuar, N (Anuar, Nuraslinda); Kim, J (Kim, Jonghyun)

ABSTRACT: In this paper, the design requirements for human-system interface of automatic systems are constructed with the help of a tool called Itemized Sequence Diagram (ISD). Eight levels of automation (LOA) are initially defined in the function allocation and an ISD is drawn for each of the LOA for task allocation. The ISD is a modified version of sequence diagram, which is widely used in systems engineering as well as software engineering. The ISD elements of arrows, messages, actors and alternative boxes collectively show the interactions between the control agents, which are decomposed into four different roles: information acquiring, plant diagnosing, response selecting and response implementing. Eleven design requirements to optimize the human-automation interaction are suggested by using this method. The design requirements produced from the identified interaction points in the ISD are rationalized and how each requirement addresses the issues related to automation is discussed. We also identify which requirements address which of the stated automation issues and at which operational process stage each requirement applies to. Finally, the strengths of the proposed methodology and its implication on the HSI design are discussed in comparison with the methodology used to produce the existing guidelines or guidance. (C) 2013 Elsevier Ltd. All rights reserved.

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Efficient Implementation and Design of a New Single-Channel Electrooculography-Based Human-Machine Interface System (China) 2015

Author(s): Wu, JF (Wu, J. F.); Ang, AMS (Ang, A. M. S.); Tsui, KM (Tsui, K. M.); Wu, HC (Wu, H. C.); Hung, YS (Hung, Y. S.); Hu, Y (Hu, Y.); Mak, JNF (Mak, J. N. F.); Chan, SC (Chan, S. C.); Zhang, ZG (Zhang, Z. G.)

ABSTRACT: This brief introduces a new and practical human-machine interface (HMI) system based on single-channel electrooculography (EOG) signals. The proposed system uses a consumer wireless recording device to collect EOG and employs new encoding/decoding paradigms to convey users' intentions with EOG from eye movements including blinking and looking up. The simplicity and mobility of the system provides a comfortable and practical solution to HMI. Furthermore, to reduce the hardware complexity and power consumption of the signal processing modules of the EOG-based HMI system, a novel multiplierless implementation is developed, where all the algorithms involved, such as bandpass filtering, wavelet filtering, and support vector machine, can be realized using a limited number of adders and shifters only. Experimental results show that the proposed system offers a simple, practical, and yet reliable EOG-based HMI with low complexity and power consumption.

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Embedded Human Control of Robots Using Myoelectric Interfaces (USA) 2014

Author(s): Antuvan, CW (Antuvan, Chris Wilson); Ison, M (Ison, Mark); Artemiadis, P (Artemiadis, Panagiotis)

ABSTRACT: This paper proposes a paradigm shift on myoelectric interfaces by embedding the human as controller of the system to be operated. Using abstract mapping functions between myoelectric activity and control actions for a task, this study shows that human subjects are able to control an artificial system with increasing efficiency by just learning how to control it. The method efficacy is tested by using two different control tasks and four different abstract mappings relating upper limb muscle activity to control actions for those tasks. The results show that all subjects were able to learn the mappings and improve their performance over time. More interestingly, a chronological evaluation across trials reveals that the learning curves transfer across subsequent trials having the same mapping, independent of the tasks to be executed. This implies that new muscle synergies are developed and refined relative to the mapping used by the control task, suggesting that maximal performance may be achieved by learning a constant, arbitrary mapping function rather than dynamic subject-or task-specific functions. Moreover, the results indicate that the method may extend to the neural control of any device or robot, without limitations for anthropomorphism or human-related counterparts.

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Times Cited: 12

Number of references: 37

Tags: Human-Machine interface, Applications - medical, Human-Machine Systems

Human-machine interface for the motion control of humanoid biped robots using a graphical user interface Motion Editor (Taiwan) 2013

Author(s): Chen, CY (Chen, Chen-Yuan); Shih, BY (Shih, Bih-Yaw); Shih, CH (Shih, Chia-Hung); Wang, LH (Wang, Li-Hui)

ABSTRACT: With the rapid development of wireless communication technology and the growth in the popularity of the internet, intelligent robots can now be constructed that can replace the manpower needed to engage in dangerous work. Searching for ways to achieve humanoid robotic operation is a demanding undertaking. Practical robotic applications are difficult. Some common problems of robotic control are addressed in this work. We propose a method developed using the Motion Editor programming tool based on a graphical user interface. The results show that the Motion Editor method is able to control robotic movement well.

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Times Cited: 16

Number of references: 35

Tags: Human-Machine interface, Human-Machine Systems

Human-Machine Interfaces: Methods of Control (USA) 2015

Author(s): Edwards, J (Edwards, John)

ABSTRACT: If you are worried that artificial intelligence enabled systems are well on their way toward assuming total command of the planet, you can take some heart in the fact that there is still a great deal of important research being done in human-machine interfaces (HMIs), much of it involving signal processing. Making certain that various types of systems do precisely what their human masters demand lies at the heart of most HMI research. The current HMI field is very competitive, and academic, government, and commercial researchers are working hard to create advanced technologies that are both useful and marketable. The major trends

driving the sector include an ever-increasing demand for enhanced user efficiency; rapid growth in information technology and telecom sectors; and a continuing expansion of electronic, mobile, computer, and electromechanical applications.

Times Cited: 0

Number of references: 0

Tags: Human-Machine interface, Human-Machine Systems

A Kinect-based Gesture Recognition Approach for a Natural Human Robot Interface (Italy) 2015

Author(s): Cicirelli, G (Cicirelli, Grazia); Attolico, C (Attolico, Carmela); Guaragnella, C (Guaragnella, Cataldo); D'Orazio, T (D'Orazio, Tiziana)

ABSTRACT: In this paper, we present a gesture recognition system for the development of a human-robot interaction (HRI) interface. Kinect cameras and the OpenNI framework are used to obtain real-time tracking of a human skeleton. Ten different gestures, performed by different persons, are defined. Quaternions of joint angles are first used as robust and significant features. Next, neural network (NN) classifiers are trained to recognize the different gestures. This work deals with different challenging tasks, such as the real-time implementation of a gesture recognition system and the temporal resolution of gestures. The HRI interface developed in this work includes three Kinect cameras placed at different locations in an indoor environment and an autonomous mobile robot that can be remotely controlled by one operator standing in front of one of the Kinects. Moreover, the system is supplied with a people re-identification module which guarantees that only one person at a time has control of the robot. The system's performance is first validated offline, and then online experiments are carried out, proving the real-time operation of the system as required by a HRI interface.

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Times Cited: 0

Number of references: 23

Tags: Human-Machine interface, Human-Machine Systems

A Markerless Human-Robot Interface Using Particle Filter and Kalman Filter for Dual Robots (China) 2015

Author(s): Du, GL (Du, Guanglong); Zhang, P (Zhang, Ping)

ABSTRACT: A more natural means of communicating complex movements to a robot manipulator is where the manipulator copies the movements of human hands. This paper presents a markerless human-robot interface that incorporates Kalman filters (KFs) and particle filters (PFs) to track the posture of human hands. This method allows one operator to control dual robot manipulators by using his/her double hands without any contact devices or markers. The algorithm employs Leap Motion to determine the orientation and the position of the human hands. Although the position and the orientation of the hands can be obtained from the sensor, the measurement errors increase over time due to the noise of the devices and the tracking error. The PFs and KFs are used to estimate the position and the orientation of the human hand. The human-manipulator interface system was experimentally verified in a laboratory, and the results indicate that such an interface can successfully control dual robot manipulators even if the operator is not an expert.

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Times Cited: 10

Number of references: 28

Tags: Human-Machine interface, Human-Machine Systems

Modeling information exchange opportunities for effective human-computer teamwork (Israel) 2013

Author(s): Kamar, E (Kamar, Ece); Gal, Y (Gal, Ya'akov (Kobi)); Grosz, BJ (Grosz, Barbara J.)

ABSTRACT: The paper presents a formal model of nearly decomposable decision-making problems, NED-MDPs, and defines an approximation algorithm, NED-DECOP that computes efficient information exchange strategies. The paper shows that NED-DECOP is more efficient than prior collaborative planning algorithms for this class of problem. It presents an empirical study of the information exchange decisions made by the algorithm that investigates the extent to which people accept interruption requests from a computer agent. The context for the study is a game in which the agent can ask people for information that may benefit its individual performance and thus the group's collaboration. This study revealed the key factors affecting people's perception of the benefit of interruptions in this setting. The paper also describes the use of machine learning to predict the situations in which people deviate from the strategies generated by the algorithm, using a combination of domain features and features informed by the algorithm. The methodology followed in this work could form the basis for designing agents that effectively exchange information in collaborations with people. (C) 2012 Elsevier B.V. All rights reserved.

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Times Cited: 1
Number of references: 67
Tags: Human-Machine interface, Human-Machine Systems

NERD-middleware for IoT human machine interfaces (USA) 2016

Author(s): Czauski, T (Czauski, Thaddeus); White, J (White, Jules); Sun, Y (Sun, Yu); Turner, H (Turner, Hamilton); Eade, S (Eade, Sean)

ABSTRACT: We propose the No Effort Rapid Development (NERD) middleware framework to address the challenges of in-field HMI discovery, provisioning, communication, and co-evolution with related ICSs. Middleware services offer the ability to simplify on-demand HMI distribution and operation of ICSs. NERD leverages existing ICS device-markers (e.g., QR-codes or RFID tags) or Bluetooth low-energy protocols for rapid cyber-physical discovery and provisioning of HMIs in the field. Device-markers and Bluetooth low-energy protocols have a very limited data capacity and transmission speed, and to achieve on-device storage of HMIs, we propose using a compact data-driven domain-specific language that emphasizes data sources and sinks between the HMI and IC.

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Times Cited: 0
Number of references: 30
Tags: Human-Machine interface, Human-Machine Systems

Noncontact Hand Motion Classification Technique for Application to Human-Machine Interfaces (Japan) 2013

Author(s): Kurita, K (Kurita, Koichi)

ABSTRACT: In this paper, I present an effective noncontact technique for the measurement of human hand motion with wireless portable motion detection sensors; this technique allows the detection of the subject's hand movements. This method involves the measurement of the current generated due to the difference in the capacitance between the subject's hand and the measurement electrodes in the motion detection sensor. The two motion detection sensors are capable of detecting the direction of the subject's hand movement by measuring the time difference of the peak of the electrostatic induction current. This technique allows us to recognize the direction of the hand movement with respect to the motion detection sensors under perfect noncontact conditions.

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Times Cited: 0
Number of references: 9
Tags: Human-Machine interface, Human-Machine Systems

A novel human-robot interface using hybrid sensors with Kalman filters (China) 2014

Author(s): Zhang, P (Zhang, Ping); Du, GL (Du, Guanglong); Li, D (Li, Di)

ABSTRACT: Design/methodology/approach - In the proposed method, an inertial measurement unit is used to measure the orientation of the human hand, and a Camshift algorithm is used to track the human hand using a three-dimensional camera. Although the location and the orientation of the human can be obtained from the two sensors, the measurement error increases over time due to the noise of the devices and the tracking errors. KFs are used to estimate the location and the orientation of the human hand. Findings - The experimental results show that this method would not hinder most natural human-limb motion and allows the operator to concentrate on his/her own task. Compared with the non-contacting marker-less method (Kofman et al., 2007), this method proves more accurate and stable. Originality/value - The human-robot interface system was experimentally verified in a laboratory environment, and the results indicate that such a system can complete high-precision manipulation efficiently.

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Times Cited: 0
Number of references: 36
Tags: Human-Machine interface, Human-Machine Systems

Stretchable, Transparent, Ultrasensitive, and Patchable Strain Sensor for Human-Machine Interfaces Comprising a Nanohybrid of Carbon Nanotubes and Conductive Elastomers (South Korea) 2015

Author(s): Roh, E (Roh, Eun); Hwang, BU (Hwang, Byeong-Ung); Kim, D (Kim, Doil); Kim, BY (Kim, Bo-Yeong); Lee, NE (Lee, Nae-Eung)

ABSTRACT: Here, we describe a stretchable, transparent, ultrasensitive, and patchable strain sensor that is made of a novel sandwich-like stacked piezoresisitive nanohybrid film of single-wall carbon nanotubes (SWCNTs) and a conductive elastomeric composite of polyurethane (PU)-poly(3,4-ethylenedioxythiophene) polystyrenesulfonate (PEDOT:PSS). This sensor, which can detect small strains on human skin, was created using environmentally benign water-based solution processing. We attributed the tunability of strain sensitivity (i.e., gauge factor), stability, and optical transparency to enhanced formation of percolating networks between conductive SWCNTs and PEDOT phases at interfaces in the stacked PU-PEDOT:PSS/SWCNT/PU-PEDOT: PSS structure. The mechanical stability, high stretchability of up to 100%, optical transparency of 62%, and gauge factor of 62 suggested that when attached to the skin of the face, this sensor would be able to detect small strains induced by emotional expressions such as laughing and crying, as well as eye movement, and we confirmed this experimentally.

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Times Cited: 22
Number of references: 44
Tags: Human-Machine interface, Human-Machine Systems

Applications - Industry

A Brain-Machine Interface to Navigate a Mobile Robot in a Planar Workspace: Enabling Humans to Fly Simulated Aircraft With EEG (USA) 2013

Author(s): Akce, A (Akce, Abdullah); Johnson, M (Johnson, Miles); Dantsker, O (Dantsker, Or); Bretl, T (Bretl, Timothy)

ABSTRACT: This paper presents an interface for navigating a mobile robot that moves at a fixed speed in a planar workspace, with noisy binary inputs that are obtained asynchronously at low bit-rates from a human user through an electroencephalograph (EEG). The approach is to construct an ordered symbolic language for smooth planar curves and to use these curves as desired paths for a mobile robot. The underlying problem is then to design a communication protocol by which the user can, with vanishing error probability, specify a string in this language using a sequence of inputs. Such a protocol, provided by tools from information theory, relies on a human user's ability to compare smooth curves, just like they can compare strings of text. We demonstrate our interface by performing experiments in which twenty subjects fly a simulated aircraft at a fixed speed and altitude with input only from EEG. Experimental results show that the majority of subjects are able to specify desired paths despite a wide range of errors made in decoding EEG signals.

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Times Cited: 1
Number of references: 25
Tags: Applications - Industry, Human-Machine Systems

Cognitive Human-Machine Interface Applied in Remote Support for Industrial Robot Systems (Norway) 2013

Author(s): Kosicki, T (Kosicki, Tomasz); Thomessen, T (Thomessen, Trygve)

ABSTRACT: This paper evaluates whether the support can be provided by means of Cognitive Info-communication, communication in which human cognitive capabilities are extended irrespectively of geographical distances. The results of simple experiments show that Cognitive Info-communication is not only efficient mean to provide the support remotely, but is probably also a powerful tool to enhance interaction with any data-rich environment that require good conceptual understanding of system's state and careful attention management. Furthermore, the paper discusses data presentation and reduction methods for data-rich environments, as well as introduces the concepts of Naturally Acquired Data and Cognitive Human-Machine Interfaces.

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Times Cited: 0
Number of references: 40
Tags: Applications - industry, Human-Machine Systems

Decision-making authority, team efficiency and human worker satisfaction in mixed human-robot teams (USA) 2015

Author(s): Gombolay, MC (Gombolay, Matthew C.); Gutierrez, RA (Gutierrez, Reymundo A.); Clarke, SG (Clarke, Shanelle G.); Sturla, GF (Sturla, Giancarlo F.); Shah, JA (Shah, Julie A.)

ABSTRACT: In manufacturing, advanced robotic technology has opened up the possibility of integrating highly autonomous mobile robots into human teams. However, with this capability comes the issue of how to maximize both team efficiency and the desire of human team members to work with these robotic counterparts. To address this concern, we conducted a set of experiments studying the effects of shared decision-making authority in human-robot and human-only teams. We found that an autonomous robot can outperform a human worker in the execution of part or all of the process of task allocation (for both), and that people

preferred to cede their control authority to the robot . We also established that people value human teammates more than robotic teammates; however, providing robots authority over team coordination more strongly improved the perceived value of these agents than giving similar authority to another human teammate . In post hoc analysis, we found that people were more likely to assign a disproportionate amount of the work to themselves when working with a robot rather than human teammates only. Based upon our findings, we provide design guidance for roboticists and industry practitioners to design robotic assistants for better integration into the human workplace.

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Times Cited: 0
Number of references: 45
Tags: Applications - industry, Human-Machine systems

A design of human-machine interface for the two-modular high-temperature gas-cooled reactor nuclear power plant (China) 2014

Author(s): Jia, QQ (Jia, Qianqian); Huang, XJ (Huang, Xiaojin); Zhang, LJ (Zhang, Liangju)

ABSTRACT: A design of human machine interface (HMI) has been developed to ensure the safety and availability of the two-modular high-temperature gas-cooled reactor nuclear power plant in China. As the first design for the plant with two modules coupled to one steam turbine, the staffing arrangement and HMIs are different from current nuclear power plants (NPPs). A Distributed control system (DCS) is employed for the non-safety controls, and computerized HMIs on the consoles are the interfaces for frequent use. The necessary safety operations and displays are set on the safety console of each reactor, independently. The large display panels are designed as an overview of the whole plant, which consist of large screen displays, mimic displays and alarm tiles. The failure modes and the diversities of HMIs are analyzed. Some special human factor engineering (HFE) strategies are considered for the control authorities of the two modules, the control of the systems shared between the two modules, etc. Two different solutions for the arrangement of HMIs and staffing are discussed. For lack of operating experiences, a verification platform is built to make verification and validation (V&V) of the HMIs. After sufficient validation, the design will be realized in the demonstration construction of the high-temperature gas-cooled reactor-pebble bed module (HTR-PM) in China. (C) 2014 Elsevier Ltd. All rights reserved.

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Times Cited: 0
Number of references: 23
Tags: Applications - industry, Interface design, Human-Machine Systems

The Development of a Scale to Evaluate Trust in Industrial Human-robot Collaboration (England) 2016

Author(s): Charalambous, G (Charalambous, George); Fletcher, S (Fletcher, Sarah); Webb, P (Webb, Philip)

ABSTRACT: With industrial robots becoming increasingly integrated into production lines as a means for enhancing productivity and quality, it will not be long before close proximity industrial HRC becomes a viable concept. Since trust is a multidimensional construct and heavily dependent on the context, it is vital to understand how trust develops when shop floor workers interact with industrial robots. To this end, in this study a trust measurement scale suitable for industrial HRC was developed in two phases. In phase one, an exploratory study was conducted to collect participants' opinions qualitatively. This led to the identification of trust related themes relevant to the industrial context and a related pool of questionnaire items was generated. In the second phase, three human-robot trials were carried out in which the questionnaire items were applied to participants using three different types of industrial robots. The results were statistically analysed to identify the key factors impacting trust and from these generate a trust measurement scale for industrial HRC.

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Times Cited: 0
Number of references: 49
Tags: Applications - industry, Human-Machine Systems

Evaluation of Flexible Graphical User Interface for Intuitive Human Robot Interactions (Hungary) 2014

Author(s): Daniel, B (Daniel, Balazs); Korondi, P (Korondi, Peter); Sziebig, G (Sziebig, Gabor); Thomessen, T (Thomessen, Trygve)

ABSTRACT: A new approach for industrial robot user interfaces is necessary due to the fact that small and medium sized enterprises are more interested in automation. The increasing number of robot applications in small volume production requires new techniques to ease the use of these sophisticated systems. In this paper shop floor operation is in the focus. A Flexible Graphical User Interface is presented which is based on cognitive infocommunication (CogInfoCom) and implements the Service Oriented Robot Operation concept. The definition of CogInfoCom icons is extended by the introduction of identification, interaction and feedback roles. The user interface is evaluated with experiments. Results show that a significant reduction in task execution time and a lower number of required interactions is achieved because of the intuitiveness of the system with human centered design.

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Total Times Cited: 2
Cited Reference Count: 20
Tags: Applications - industry, Human-Machine Systems

Evaluation of hydraulic excavator Human-Machine Interface concepts using NASA TLX (USA) 2014

Author(s): Akyeampong, J (Akyeampong, Joseph); Udoka, S (Udoka, Silvanus); Caruso, G (Caruso, Giandomenico); Bordegoni, M (Bordegoni, Monica)

ABSTRACT: The effectiveness of these three HMI designs in terms of the reduction of the operators' mental and physical worldoad were assessed by conducting experiments utilizing human subjects, ages 23–35 years. The National Aeronautics and Space Administration's Task Load Index (NASA TLX) method was used for collecting subjective workload scores based on a weighted average of ratings of six factors: Mental Demand, Physical Demand, Temporal Demand, Own Performance, Effort, and Frustration Level. The results showed that the type of HMI design affects different aspects of the operator's workload. Indeed, it showed how the proposed augmented interaction is an effective solution for reducing the ergonomic gaps in terms of mental workload, and to a lesser extent the physical workload, subjected by the standard HMI design. Relevance to industry: This study proposes innovative HMI solutions featuring heads-up display and coordinated control to improve the ergonomics of the hydraulic excavator HMI, particularly in reducing the operators' mental and physical workload. The results of this study promises to be an innovative approach for developing new HMI designs by hydraulic excavator manufacturers. (C) 2014 Elsevier B.V. All rights reserved.

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Times Cited: 1
Number of references: 35
Tags: Applixations - industry, Human-Machine interface, Human-Machine Systems

Human-robot-environment interaction interface for robotic grit-blasting of complex steel bridges (Thailand) 2012

Author(s): Chotiprayanakul, P (Chotiprayanakul, P.); Liu, DK (Liu, D. K.); Dissanayake, G (Dissanayake, G.)

ABSTRACT: This paper presents a human-robot-environment interaction (HREI) interface using haptic feedback for a grit-blasting robot operating in close proximity to a complex steel bridge structure. The productivity requirements dictate the need for efficient algorithms for mapping, exploration, and collision-free motion planning. While a large portion of the grit-blasting operation can be automated, a tele-operation is essential to deal with some difficult to access sections such as edges, complex corners, and surfaces which can only be approached through hole. A 3-dimensional virtual force field (3D-VF2) method is developed for capturing the relationship between the robot and its environment. A novel haptic force generation method and a workspace mapping algorithm allow intuitive interaction between the operator and the robot through haptic feedback. The strategies presented are verified in extensive simulations and experiments conducted on a steel bridge with a prototype grit-blasting robot. (C) 2012 Elsevier B.V. All rights reserved.

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Times Cited: 1

Number of references: 35

Tags: Applications - industry, Human-Machine Systems

Optimal Subtask Allocation for Human and Robot Collaboration Within Hybrid Assembly System (Japan) 2014

Author(s): Chen, F (Chen, Fei); Sekiyama, K (Sekiyama, Kosuke); Cannella, F (Cannella, Ferdinando); Fukuda, T (Fukuda, Toshio)

ABSTRACT: We introduce a folk-joint task model that describes the sequential and parallel features and logic restriction of human and robot collaboration appropriately. To preserve a cost-effectiveness level of task allocation, we develop a logic mathematic method to quantitatively describe this discrete-event systemby considering the system tradeoff between the assembly time cost and payment cost. A genetic based revolutionary algorithm is developed for real-time and reliable subtask allocation to meet the required cost-effectiveness. This task allocation strategy is built for a human worker and collaborates with various robot co-workers to meet the small production situation in future. The performance of proposed algorithm is experimentally studied, and the cost-effectiveness is analyzed comparatively on an electronic assembly case.

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Times Cited: 2

Number of references: 39

Tags: Applications - industry, Human-Machine Systems

Optimal task allocation in multi-human multi-robot interaction (Canada) 2015

Author(s): Malvankar-Mehta, MS (Malvankar-Mehta, Monali S.); Mehta, SS (Mehta, Siddhartha S.)

ABSTRACT: A multi-level programming model is developed in which an agent allocates information received from multiple robots to multiple team leaders who in turn distribute information to operators within their teams. The objective of the agent is to optimally allocate tasks to multiple team leaders to maximize the overall system performance and to minimize the processing cost and time while considering human factors. The developed model is solved using backward induction and details are presented in reverse time sequence. If human factors are included along with the productivity metrics then the performance of the multi-human multi-robot interaction systems can be improved.

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Times Cited: 0
Number of references: 26
Tags: Applications - industry, Human-Machine Systems

Toward Nonconventional Human-Machine Interfaces for Supervisory Plant Process Monitoring (Slovakia) 2013

Author(s): Skripcak, T (Skripcak, Tomas); Tanuska, P (Tanuska, Pavol); Konrad, U (Konrad, Uwe); Schmeisser, N (Schmeisser, Nils)

ABSTRACT: This paper describes a novel methodology for designing alternative human-machine interfaces (HMI) dealing with the industrial process control visualization and plant monitoring. The system is based on a multiagent approach in order to allow visualizations using nonconventional display devices (e. g., power-wall or table) combined with the natural user interaction (NUI) paradigm. This type of HMI solution could form an optional extension to current systems employed in a plant monitoring. Namely the utilization of a virtual reality creates new opportunities for the HMI system use cases, where an enhanced visualization and interaction can improve decision making strategies in complex processes. We applied the multiagent approach, which leads to a more robust and less-coupled component structure. An experimental prototype was implemented on the top of the proposed methodology. Furthermore, in order to optimize our NUI agent, a user testing application was developed for the evaluation of exploratory interaction tasks in a power-wall display scenario. The proposed framework provides fundamental guidelines for designing and developing a new generation of HMI systems.

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Times Cited: 3
Number of references: 42
Tags: Applications - industry, Human-Machine Systems

Applications - Medical

A comparative analysis of three non-invasive human-machine interfaces for the disabled (Germany) 2014

Author(s): Ravindra, V (Ravindra, Vikram); Castellini, C (Castellini, Caludio)

ABSTRACT: In this paper, we compare three such HMIs employed in the detection of finger forces, namely sEMG, ultrasound imaging, and pressure sensing. The comparison is performed along four main lines: the accuracy in the prediction, the stability over time, the wearability, and the cost. A psychophysical experiment involving ten intact subjects engaged in a simple finger-flexion task was set up. Our results show that, at least in this experiment, pressure sensing and sEMG yield comparably good prediction accuracies as opposed to ultrasound imaging; and that pressure sensing enjoys a much better stability than sEMG. Given that pressure sensors are as wearable as sEMG electrodes but way cheaper, we claim that this HMI could represent a valid alternative/augmentation to sEMG to control a multi-fingered hand prosthesis.

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Times Cited: 1
Number of references: 40
Tags: Application - medical, Interface, Human-Machine Systems

Control of Upper-Limb Power-Assist Exoskeleton Using a Human-Robot Interface Based on Motion Intention Recognition (China) 2015

Author(s): Huang, J (Huang, Jian); Huo, WG (Huo, Weiguang); Xu, WX (Xu, Wenxia); Mohammed, S (Mohammed, Samer); Amirat, Y (Amirat, Yacine)

ABSTRACT: In this paper, an intention-guided control strategy is proposed and applied to an upper-limb power-assist exoskeleton. Meanwhile, a human-robot interface comprised of force-sensing resistors (FSRs) is designed to estimate the motion intention of the wearer's upper limb in real time. Moreover, a new concept called the "intentional reaching direction (IRD)" is proposed to quantitatively describe this intention. Both the state model and the observation model of IRD are obtained by studying the upper limb behavior modes and analyzing the relationship between the measured force signals and the motion intention. Based on these two models, the IRD can be inferred online using an adapted filtering technique. Guided by the inferred IRD, an admittance control strategy is deployed to control the motions of three DC motors placed at the corresponding joints of the robotic arm. The effectiveness of the proposed approaches is finally confirmed by experiments on a 3 degree-of-freedom (DOF) upper-limb robotic exoskeleton.

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Times Cited: 0
Number of references: 38
Tags: Application - medical, Interface, Human-Machine Systems

Human-Machine Interface for the Control of Multi-Function Systems Based on Electrocutaneous Menu: Application to Multi-Grasp Prosthetic Hands (Japan) 2015

Author(s): Gonzalez-Vargas, J (Gonzalez-Vargas, Jose); Dosen, S (Dosen, Strahinja); Amsuess, S (Amsuess, Sebastian); Yu, WW (Yu, Wenwei); Farina, D (Farina, Dario)

ABSTRACT: In this study, we propose a novel concept for a general-purpose HMI where the controller and the user communicate bidirectionally to select the desired function. The system first presents possible choices to the user via electro-tactile stimulation; the user then acknowledges the desired choice by generating a single command signal. Therefore, the proposed approach simplifies the user communication interface (one signal to generate), decoding (one signal to recognize), and allows selecting from a number of options. We performed experiments in healthy subjects and with one amputee to test the feasibility of the novel approach. The results showed that the performance of the novel HMI concept was comparable or, for some outcome measures, better than the classic myoelectric interfaces. The presented approach has a general applicability and the obtained results point out that it could be used to operate various assistive systems (e.g., prosthesis vs. wheelchair), or it could be integrated into other control schemes (e.g., myoelectric control, brain-machine interfaces) in order to improve the usability of existing low-bandwidth HMIs.

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Times Cited: 0
Number of references: 53
Tags: Application - medical, Interface design, Human-Machine Systems

Human-Machine task allocation: Impact on patient safety in hospital settings (France) 2015

Author(s): Pelayo, S (Pelayo, S.); Marcilly, R (Marcilly, R.); Anceaux, F (Anceaux, F.); Bernonville, S (Bernonville, S.); Beuscart-Zephir, MC (Beuscart-Zephir, M. -C.)

ABSTRACT: The paper aims at evaluating the impact of the tasks' allocation between human and machine on the efficiency of work systems in the healthcare domain. Usability testing was performed to compare two different tasks' allocations depending on two different systems (semi-automated system vs. manual system) for the tasks of preparing and administering the drugs in hospital settings. The results show that the allocation of tasks with the semi-automated system seems to produce a better performance in terms of task durations compared to the manual cabinet. Concerning safety goals, the semi-automated system seems to fix known common errors generated by the manual system. But it seems also to bring new errors more numerous that can be easily fixed. The main problem highlighted by the study lies in the risks of automation exposure over time. After a one-hour simulation, participants already have the feeling of loss of control and present a disengagement. The tasks' allocation with the semi-automated system changes in fact the nature of the feedback provided to nurses and then under-specifies the cognitive operations of nurses. Design recommendations were given in order to give back part of the control to nurses through the reallocation of tasks. (C) 2014 Societe francaise de psychologie. Published by Elsevier Masson SAS. All rights reserved.

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Times Cited: 0
Number of references: 28
Tags: Application - medical, Human-Machine Systems

Human-robot skills transfer interfaces for a flexible surgical robot (Italy) 2014

Author(s): Calinon, S (Calinon, Sylvain); Bruno, D (Bruno, Danilo); Malekzadeh, MS (Malekzadeh, Milad S.); Nanayakkara, T (Nanayakkara, Thrishantha); Caldwell, DG (Caldwell, Darwin G.)

ABSTRACT: The aim of the STIFF-FLOP European project is to develop a soft robotic arm to perform surgical tasks. The flexibility of the robot allows the surgeon to move within organs to reach remote areas inside the body and perform challenging procedures in laparoscopy. This article addresses the problem of designing learning interfaces enabling the transfer of skills from human demonstration. Robot programming by demonstration encompasses a wide range of learning strategies, from simple mimicking of the demonstrator's actions to the higher level imitation of the underlying intent extracted from the demonstrations. In contrast to inverse reinforcement learning strategies that attempt to explain the observations with reward functions defined for the entire task (or a set of pre-defined reward profiles active for different parts of the task), the proposed approach is based on context-dependent reward-weighted learning, where the robot can learn the relevance of candidate objective functions with respect to the current phase of the task or encountered situation. The robot then exploits this information for skills refinement in the policy parameters space. The proposed approach is tested in simulation with a cutting task performed by the STIFF-FLOP flexible robot, using kinesthetic demonstrations from a Barrett WAM manipulator. (C) 2014 Elsevier Ireland Ltd. All rights reserved.

Author Keywords: Robot-assisted surgery; Soft robotics; Learning from demonstration; Skills transfer; Inverse reinforcement learning; Stochastic optimization
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Times Cited: 5
Number of references: 43
Tags: Application - medical, Interface design, Human-Machine Systems

Similarities and differences of emotions in human-machine and human-human interactions: what kind of emotions are relevant for future companion systems? (Germany) 2014

Author(s): Walter, S (Walter, Steffen); Wendt, C (Wendt, Cornelia); Bohnke, J (Boehnke, Jan); Crawcour, S (Crawcour, Stephen); Tan, JW (Tan, Jun-Wen); Chan, A (Chan, Andre); Limbrecht, K (Limbrecht, Kerstin); Gruss, S (Gruss, Sascha); Traue, HC (Traue, Harald C.)

ABSTRACT: We focused on what emotions in the experienced scenarios of HMI are retroactively reflected as compared with HHI. The sample consisted of N=145 participants, who were divided into two groups. Positive and negative scenario descriptions of HMI and HHI were given by the first and second groups, respectively. Subsequently, the participants evaluated their respective scenarios with the help of 94 adjectives relating to emotions. The correlations between the occurrences of emotions in the HMI versus HHI were very high. The results do not support the statement that only a few emotions in HMI are relevant. Practitioner Summary: This study sought to identify the relevant emotions in different technical domains their companion systems tend to use. Overall, the 20 essential emotions found as highly relevant for HMI were as follows: (i) positive, i.e. satisfied, pleased, happy, relieved, pleasant, well, serene, optimistic, confident and self-confident and (ii) negative, i.e. annoyed, aggravated, impatient, angry, unsatisfied, displeased, irritable, frustrated, enraged and tense.

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Times Cited: 2
Number of references: 45
Tags: Application - medical, Human-Machine Systems

Special Issue Risk management in medical human-machine systems (Germany) 2016

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Times Cited: 0
Number of references: 9
Tags: Application - medical, Human-Machine Systems

Applications - Military

An agent-based simulation model of human-robot team performance in military environments (USA) 2013

Author(s): Giachetti, RE (Giachetti, Ronald E.); Marcelli, V (Marcelli, Veronica); Cifuentes, J (Cifuentes, Jose); Rojas, JA (Rojas, Jose A.)

ABSTRACT: This paper describes a multiagent simulation model that captures both team coordination and human-robot interaction. The purpose of the model is to evaluate proposed team designs in uncertain Military Operations in Urban Terrain (MOUT) scenarios and determine which design factors are most critical to team performance. The simulation model is intended to be a tool in the systems engineering iterations of proposing designs, testing them, and then evaluating them during the conceptual design phase. To illustrate the model's usefulness for this purpose, a fractional factorial design of experiments is conducted to evaluate team design factors and the two-factor interaction between controllable factors and noise factors that described the environment and robot reliability. The experimental results suggest that (1) larger teams have more robust performance over the noise factors,

(2) robot reliability is critical to the formation of human-robot teams, and (3) high centralization of decision-making authority created communication bottlenecks at the commander in large teams. This work contributes to the agent-based modeling of teams, and to understanding how the U.S. Army can attain its goal of greater utilization of robots in future military operations. (C) 2012 Wiley Periodicals, Inc. Syst Eng Author affiliation: [Giachetti, Ronald E.] USN, Postgrad Sch, Monterey, CA 93943 USA.

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Intelligent Agent Transparency in Human-Agent Teaming for Multi-UxV Management (USA) 2016

Author(s): Mercado, JE (Mercado, Joseph E.); Rupp, MA (Rupp, Michael A.); Chen, JYC (Chen, Jessie Y. C.); Barnes, MJ (Barnes, Michael J.); Barber, D (Barber, Daniel); Procci, K (Procci, Katelyn)

ABSTRACT: Objective: We investigated the effects of level of agent transparency on operator performance, trust, and workload in a context of human-agent teaming for multirobot management. Results: Results indicate that operator performance, trust, and perceived usability increased as a function of transparency level. Subjective and objective workload data indicate that participants' workload did not increase as a function of transparency. Furthermore, response time did not increase as a function of transparency. Conclusion: Unlike previous research, which showed that increased transparency resulted in increased performance and trust calibration at the cost of greater workload and longer response time, our results support the benefits of transparency for performance effectiveness without additional costs. Application: The current results will facilitate the implementation of IAs in military settings and will provide useful data to the design of heterogeneous UxV teams.

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Optimizing human-robot teleoperation interfaces for mobile manipulators (USA) 2013

Author(s): Will, JD (Will, Jeffrey D.); Moore, KL (Moore, Kevin L.); Lynn, IK (Lynn, Ian K.)

ABSTRACT: Purpose - Mobile manipulators offer great capability, but their teleoperation is often an overwhelming task for humans due to the many degrees-of-freedom of control available from both the mobile platform and the associated manipulator. The purpose of this paper is to address the question of how these controls should be mapped to the robotic mobile platform and its manipulator for "optimal teleoperation", for the special case of an omnidirectional mobile platform and two joint (with wrist) planar manipulator. Findings - The research comprised a carefully-controlled study using 33 human subjects in seven different treatments of possible control interfaces. Practical implications - Based on this study, the authors present guidelines for optimizing mobile manipulator control interfaces and motivate future research using the method of controlled multi-user trials. Social implications - This research has the potential to guide the improvement of interfaces for mobile robots in military, service, and security applications.

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Seven Cardinal Virtues of Human-Machine Teamwork: Examples from the DARPA Robotic Challenge (USA) 2014

Author(s): Johnson, M (Johnson, Matthew); Bradshaw, JM (Bradshaw, Jeffrey M.); Hoffman, RR (Hoffman, Robert R.); Feltovich, PJ (Feltovich, Paul J.); Woods, DD (Woods, David D.)

ABSTRACT: As counterpoint to the authors' previous discussions of the "seven deadly myths" of autonomous systems, here they present seven design principles to be understood and embraced for the virtues they engender.

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