Research Training Group 2323:
Conducive Design of Cyber-physical Production Systems

Hybrid Societies:
Humans Interacting with Embodied Technologies

Joint Lecture Series
Summer Semester 2021

Date	Speaker	Title and Abstract
19.04.2021	**Prof. Georg Jahn** **Dr. Diana Armbruster**	**Introduction of the CRC 1410 (TU Chemnitz)**
	Prof. Leon Urbas	**Introduction of the Research Training Group 2323: Conducive Design of CPPS (TU Dresden)**
26.04.2021	**Amin Dadgar**	**SaneSegmentation: Hand Segmentation Using Synthetic Data and Repetitive Training** We propose a novel learning strategy for the training of neural networks when the dataset is large and mainly contains synthetic (with a few real) images. We orient the experiments toward the task of hand segmentation. However, our approach seeks to address more general problems that arise with premature learning saturation states. That state occurs when the dataset is large and implies that the networks mainly learn from the initial portions of the training set. Subsequently, that causes the nets to almost neglect the rest of the data during the learning phase. The employed strategy to overcome that undesired saturation has the nomenclature of repetitive training. We test and train several networks to evaluate the efficacy of the method from various perspectives (still an ongoing process). The results suggest the suitability of our proposed strategy, subject to appropriately selecting that real images.
	Marc Satkowski	**Extending our Reality: User Evaluation of Augmented Reality Applications** Augmented Reality (AR) is an emerging technology, which allows extending our real-world environment with additional virtual information and objects. This is especially helpful as the ubiquity of information and the connected need to visualize and interact with those increases. AR can be made useable by wearing a head-mounted display (HMD), that, in combination with commercial products being increasingly available, can elevate them to a ubiquitous tool, which is always accessible by the users. However, besides the advancements in regards to the general technology or the application design and implementation, it is also important to be mindful of the users of AR HMDs. In this talk, I want to present current research, which focuses on extending our reality and that evaluates how users of AR applications experience system and concept designs. Further, challenges while creating or conducting user studies with AR HMDs will also be part of this talk. With this, I want to show how a user-centric approach allows for the creation of conducive application designs that can be adapted to the needs of the users.

03.05.2021	**Ann-Christin Hensch**	**Predicting Lane Changes by Identifying Sequence Patterns of Implicit Communication Cues** Automated driving offers the benefits of increased road safety, traffic efficiency and enhanced driving comfort. Manual drivers mainly use implicit driving cues to communicate and anticipate prospective driving actions. In order to provide familiar and intuitive interactions, automated vehicles (AVs) also need to be able to detect and apply implicit communication cues to enhance the human users' acceptance and thus exploit the benefits of automated driving functions. Lane changes (LCs) are highly complex driving actions, therefore the announcement and anticipation at an early stage of these maneuvers is important for traffic safety. The current study aimed at identifying communication cues and prototypical sequence patterns that announce prospective LCs at an early stage. In total, N = 298 LCs were annotated in video recordings of a real-world driving data set. The analysis revealed the turn indicator and the vehicles' lateral movement towards the target lane as the most frequently and initially applied communication cues to announce upcoming LCs. The identified driving cues could be used by AVs to announce and anticipate prospective LCs at an early stage of the maneuver. Therefore, cooperative interactions with surrounding traffic participants and thus traffic safety and efficiency could be enhanced in automated driving.
	Yuxuan Guo	**Eye Movement Patterns in Complex Task: Characteristics of Ambient and Focal Processing** Analyzing the time course of eye movements in scene viewing often reveals a systematic increase in fixation durations and a decrease in saccade amplitudes. These temporal changes in eye movement parameters have been explained as a shift from ambient to focal processing. However, much of the research on ambient and focal processing mechanisms to date has focused on static scene viewing, few studies have investigated ambient and focal attention in complex active task solving paradigms. In my presentation, I will mainly talk about our Rubik's Cube task paradigm which is designed for studying the characteristics of ambient and focal attention in the context of complex task processing. The nature of the task required that the information gathering, visual searching, and model construction sub-tasks be executed in repeating sequences. Common temporal changes and particular characteristics in eye movement patterns were observed during task/subtasks processing. Moreover, while subjects' task performances and solving strategies varied over time, the ambient-to-focal processing strategy would remain stable.
17.05.2021	**André Langer**	**PIROL: Publishing Interdisciplinary Research Over Linked data** Publishing research data so that other scientists can find these datasets and reuse them, replay them or repurpose them is an increasing demand in the digitization process of Open Science. One major difficulty is, that research data is commonly not self-descriptive and requires additional comprehensive descriptions to increase its discoverability. This task is especially challenging in an interdisciplinary context, as it requires a common language, appropriate tool assistance and high-quality information provision. PIROL is a second-half PhD project that addresses these challenges by applying semantic technologies to the research data publishing process. It is exemplarily demonstrated in the context of Hybrid Societies research. We establish a machine-readable, SKOS-based taxonomy service, then establish three types of user input interfaces based on traditional forms, automatic knowledge extraction and conversational interfaces, and finally evaluate their feasibility, UIX and output metadata quality.
	Nazanin Hamedi	**Adding Work Domain Analysis to Human Machine Interface of Modular Plants** Human machine interfaces of chemical process plants are of significant importance as they should support the operators with fault diagnosis, collaborative tasks, and adaptation to unanticipated events. Hierarchical structures, as the basis of visualization, play an important role in making visual objects in an interface comprehensible. In fact, the hierarchical structures of chemical processes should be designed in a way to result in understandable schemes of the real processes. In this presentation, at first, Ecological Interface Design as a human centered hierarchical structure for designing an interface for chemical process control rooms will be explained. Then, the conventional hierarchical structures of modular process plants will be compared with these human centered hierarchies.

24.05.2021	**Maximilian Bretschneider** **Sarah Mandl**	**Technicalities? Anthropomorphism and Social Perception** In the course of digitalization and automation of working processes, robots have become increasingly common in work spaces. Therefore, concerns regarding the use of robots as well as qualities they should possess to be accepted as 'co-workers' need to be investigated. The Stereotype Content Model differentiates two fundamental dimensions of social perception, warmth and competence. Previous research showed that individuals with disabilities are perceived as warm and incompetent, but using bionic prostheses increases the perception of competence, while cyborgs are perceived as competent and cold. In accordance with Leach et al. (2007), the present study differentiates the warmth dimension into sociability and morality to gain deeper insight in how people with or without disabilities and/or with or without bionic prostheses are perceived. In addition, we extend our research question to the perception of robots, such as industrial or social robots. In total, N = 338 participants rated eleven visual stimuli of individuals with or without disabilities and low- or high-tech prostheses as well as different kinds of robots in terms of sociability, competence, anthropomorphism, and morality by using a semantic differential scale. First analyses have shown that at least some humane attributions, especially those regarding perceived morality, cannot be adequately attributed to robots. Additionally, only warmth varied as a function of technical sophistication of the prostheses, but not competence. Overall, this study provides a contribution to technological design, which aims to ensure high acceptance with minimal undesirable side effects, both with regard to the application of bionic instruments and robotics.
	Felix Miesen	**Design and Evaluation of Competence-oriented Assistance Strategies: How Competence Modelling Can Contribute to System Design** Cyber-physical productions systems (CPPS) are highly automated complex socio-technical systems with an architecture allowing for re-configurations in rather short time spans. To successfully operate CPPS, operators need certain competencies and an adequate mental model. As operators have less chances to consolidate or expand their competencies by working with the system, operators face a loss of competencies. To mitigate these effects, new ways of human-machine-interaction have to be established. This talk tackles this question and deals with a research approach combining competence modelling and system design of CPPS to design and evaluate competence-oriented assistance strategies.
07.06.2021	**Rajarajan Ramalingame**	**Implementation of Polymer-Nanocomposite Sensors for Body-Attached Sensor Systems** Conventional camera-based systems for gesture recognition are limited by the influence of lighting conditions, occlusions, and space restrictions. A wearable solution such as a SmartBand or SmartGlove with integrated nanocomposite sensors can potentially overcome these shortcomings. The sensors consist of homogeneously dispersed carbon nanotubes in a polymer matrix prepared by an optimized synthesis process. These wearable solutions can actively monitor contractions/relaxations of muscles in the arm and flexion of the fingers. The sensors are soft, biocompatible, flexible and have high sensitivity to low forces, excellent stability, and reproducibility. The SmartBand consists of 8 pressure sensors to monitor the muscle action and the SmartGlove is equipped with 5 filament strain sensors, one for each finger to monitor the flexion, upon performing a gesture. These sensors will be interfaced to a portable, body-attachable embedded solution for real-time classification of recognition of gestures.
	Hannes Ernst	**Non-Contact Vital Parameter Monitoring with Camera-Based Photoplethysmography** Camera-based photoplethysmography is an optical technique for non-contact acquisition of essential vital signs that is suitable for unobtrusive monitoring. Each contraction of the heart initiates a pulse wave that propagates through the vascular system. This pulse wave reaches, among other regions, the skin of the face. Here, pulsating blood vessels modulate the optical properties of the upper skin layers, resulting in a slight change in color. Although this effect is too small to be perceived by the naked eye, it can be detected with the aid of optoelectronic transducers. Using heart rate measurement as an example, the fundamental functional principles as well as the main challenges of the technology will be discussed. Particularly against the background of continuous monitoring, the question of how to improve the robustness of camera-based measurements will be addressed.

14.06.2021	**Giuseppe Sanseverino**	**Multibody Simulation to Virtual Assess Body-Attached Sensor Networks** The evaluation of Body-Attached Sensor Networks would require many laboratory tests with many replications to ensure good statistical significance. On the contrary, virtual simulation ensures a high level of flexibility as well as the ability to replicate a motion in the same way at any time. In addition, many different sensor arrangements can be tested with minimal effort. The aim of this work is to use a virtual environment to obtain information about the best type, number and location of sensors to develop effective Body-Attached Sensor Networks for gesture recognition. This talk will provide a brief introduction to the multibody models of human body parts used and the library of digital twins of sensors currently being developed in MATLAB Simulink.
	Jonas Miesner	**Ergonomic design through modular screening development of the "Neutral-0 Posture Analysis" method** Ergonomic screening methods in computer-aided form are state of the art. For the assessment of postures, which generally form an integral part of screening methods, threshold values function as classification criteria for weighted characteristics of physical workload. The potential to use these characteristics across methods can improve the quality of risk analyses. The aim is to modularize posture analyses so that such characteristics of physical workload can complement each other across methods and be used as a part of modular screening methods.
21.06.2021	**Katharina Jahn**	**Anthropomorphism of Embodied Digital Technologies** Embodied digital technologies (EDTs) are slowly becoming a part of our daily life, for example in the form of smart personal assistants or pedagogical agents. The use of EDTs is associated with hopes to increase a range of beneficial outcomes, for example for health or learning. However, not all EDTs are readily accepted by potential users. Thus, designing EDTs with the aim to increase their acceptance is crucial to achieve these positive outcomes. One way to increase acceptance of EDTs is to design them with anthropomorphic design features to elicit anthropomorphism. Anthropomorphism can be defined as the attribution of visual and mental characteristics to nonhuman entities and is influenced by unconscious, implicit processes and conscious, reflective processes. However, which specific design features in relation to EDTs' visual and mental characteristics facilitate implicit and explicit anthropomorphism and de-anthropomorphism processes determining acceptance is still unclear. This talk gives an overview on how emotional capabilities as well as visual characteristics can affect anthropomorphism and acceptance of EDTs.
	Franziska Keßler	**Enhancing Sensitivity for Causal Structures: Implications for Solving Complex Problems** In the light of frequently changing system configurations in modular chemical plants, operators' ability to make use of previously acquired knowledge and to transfer it to new system configurations becomes increasingly important. Structurally mapping two situations that are superficially distinct, but share the same underlying causal structure, enables operators to draw analogical inferences and thus to generate solutions to novel problem situations. The ability to detect the causal structure of situations is associated with expertise. Goldwater and Gentner (2015) showed that an intervention combining explication of causal models and structural alignment of two situations from disparate fields with the same underlying causal model significantly increased the sensitivity for causal structures. Going beyond this finding, we extended this intervention with inference questions and combined it with a subsequent complex problem solving (CPS) task, in order to investigate whether enhanced sensitivity for causal structures would result in better performance in CPS. I will present results of this study (N = 108) in which we compared CPS performance indicators knowledge acquisition and knowledge application among three experimental groups (intervention, intervention extended with inference questions, control group).

28.06.2021	**Max Theisen**	**To Cross or Not to Cross: An Online Two-Alternative Choice Study to Analyze Pedestrians' Decision-Making with a Drift-Diffusion-Model** As a consequence of the large variability of human behavior, human-vehicle interaction has remained the biggest challenge for the deployment of autonomous vehicles to the public. Therefore, great efforts have been made to design models that are capable of describing human behavior in traffic interactions by considering the underlying decision-making processes (e.g. Markkula et al., 2018). One class of models is based on the drift-diffusion-model (Ratcliff, 1978) and explains how road users make decisions by accumulating noisy evidence over time until a threshold is reached. Here we aim at extending this approach to a road-crossing scenario. Pedestrians' decision-making when crossing a road is investigated in an online video study with a two-alternative choice reaction task. Results are interpreted with two different drift-diffusion-model frameworks, the HDDM (Wiecki et al., 2013) and the PyDDM (Shinn et al., 2020).
	Florian Pelzer	**Classical Safety Engineering Approach vs. Functional Safety Orchestration: How Engineering Design Can Influence an Operator's Tasks and Competencies in CPPS** The flexibilization of modular plants poses new challenges for risk reduction procedures with Process Control Technology safety devices. On the one hand, the static functional safety procedures must be adapted to the dynamic usage context of modular plants. At the same time, both the adaptation of the plant topology and the module configuration must be kept as simple as possible so that an operator can modify the systems without in-depth safety engineering training. To meet these requirements, a new safety strategy - the so-called Functional Safety Orchestration (FSO) - has been developed to satisfy both demands. In this presentation, the concept of FSO and the modular safety life cycle will be given in addition to the presentation of challenges and opportunities of functional safety in modular systems. Further, current research approaches to identify activities and competencies needed to perform safety-related exchange of Modules and Sub-Modules within the FSO concept will be described.
05.07.2021	**Carl Gäbert**	**Generating Human-like Robotic Arm Motions** Sampling-based motion planning algorithms are widely used in robotics applications. However, they become ineffective with a growing size of the planning space. This often leads to purely functional paths or long planning times. The aim of this work is to learn a manifold of optimal paths and generate samples in relevant sub-regions of the configuration space. This non-uniform sampling strategy can be used to guide a wide range of well-established planners. We achieve an improvement in planning time and costs by an order of magnitudes. The proposed methodology is thus relevant for applications in human-robot interaction where fast and optimal motion planning is important for the overall acceptance.
	Martin Gebert	**An Optimized Product Verification Process: Enabling Efficient Design Reviews in Virtual Reality** Design reviews are an established component of the product development process. Especially, virtual reality design reviews (VRDRs) can generate valuable feedback on the user perception of a virtual product. However, for adaptable products, there is a lack of a generalized approach to adapt and verify a product on the user in a VR environment. In the thesis, I present a strategy for adaptable and recordable VRDR sessions. The strategy provides means to describe both adaptable products and users in a combined scene graph representation, enabling the adaptation of a product to the user's needs. By recording VRDRs in structured and coherent reports, gathering feedback for optimized products can be simplified.

12.07.2021	**Konstantin Felbel**	**Naturalistic Driving Study: What Automated Vehicles Can Learn from Human Drivers** In manual driving, implicit cues play an important role in the communication of intention and anticipation of upcoming driving situations. Considering mixed traffic situations, all interaction partners need to be able to detect and interpret implicit cues, as they are central to design smooth, efficient, and safe driving styles. However, most current automated driving functions do not incorporate the communication and anticipation of implicit cues. The lack of anticipation of upcoming events in automated driving increases the probability of inadequate actions (e.g., sudden breaking maneuver). This concerns especially highway situations as the driving speeds are considerable high, requiring more anticipation. To show the importance of implicit cues, I will present a study on German highway where over 1000 km of 360° video material was recorded. It was then annotated with the focus on the identification of situations where implicit cues can be observed. Beside the findings of the study, I will give an outlook on a naturalistic driving study design to examine implicit cues during the drive.
	Sebastian Lorenz	**Competency Conducing Human-Machine Interfaces for Agricultural Machinery** The transition to highly flexible CPPS in mobile agricultural systems poses severe challenges for operators, which remain important as decision-makers and troubleshooters. As the systems degree of automation (DOA) increases, task profiles and work roles will change. The amount of monitoring tasks will increase, several machines have to be operated simultaneously and systems and processes might lose transparency. To ensure safe and reliable operation, the consideration of human-based metrics like cognitive workload or situational awareness remains important. Based on an in-depth analysis of tasks and required competency profiles, interaction forms will be evaluated in terms of their capability/quality to consider a defined set of key competencies in a conducive manner.
19.07.2021	**Francisco Hernandez**	**Implementing a Telepresence Robot in an Industrial Environment** Working remotely for long periods of time directly impacts the employees' productivity, engagement, and motivation due to isolation and the lack of informal and spontaneous communication with colleagues within the work environment. Exploiting the best of face-to-face meetings and remote work is, without a doubt, needed. An alternative is the broader usage of telepresence robots (TPR). A TPR is a video conference system with remote control movement capabilities. The TPR driver (e.g., at home) can move independently and interact with people in a different location (e.g., at the office). The freedom of movement and the independent point of view given by the TPR are features that cannot be achieved with a regular video call. The communication is perceived as more natural due to the driver's physical presence via the TPR. For several years TPRs have been used to promote social interaction in office, academic, and medical environments, but it has not been implemented in an industrial context. Until this date, there is no known formal research for TPRs applications in industrial environments. This opens new research and potential application fields that need to be explored further. The TPR can be applied as a hands-free remote assistance tool and expand a practical implementation of telepresence. The benefits of a TPR for remote assistance in a production environment, the positive effect on discussion and exchange of information, the importance of being physically pre-sent versus telepresence (physical robot, digital person) will be examined later on. The presentation provides an overview of a series of preliminary tests and interviews with technical users and industry experts to determine suitable implementation scenarios and requirements for the TPR in an industrial environment. An initial set of requirements and four possible application scenarios will be presented.