November 6, 2016 (Sunday)

Lightning Talks

8:30am - 10:00am

MIT Stata Center (32-123)

Haptic Feedback in Virtual Reality Environments for Rehabilitation Therapy

Perri Lomberg (Northeastern University)

Virtual reality systems in which users use body movements to interact with objects in a virtual environment is a promising rehabilitation treatment option. Low-cost, commercially-available VR systems and games lack haptic feedback - a sense of touch - and this decreases the realism of the interaction and could have important effects on transfer of skills from a virtual to a real-life environment. In order to enhance the immersive experience of users in VR we have designed a tactile exoskeleton that can simulate different textures. The exoskeleton monitors the position and muscle activation of the limb and responds by activating muscle antagonists opposite the direction of movement, giving the sensation that the user is moving underwater or in slow motion. We demonstrate this technology by intersecting enhanced haptic feedback with visually stimulating virtual reality environments.

Interactive Robotic Mannequin

Aryuna Dashidorzhina (New York College of Technology)

Life size robotic mannequins designed for the fashion and retail industry are rare and expensive. Even though the New York City fashion industry is eager to adopt technology to enhance and improve their business, the extremely high cost and specialized nature of robotic mannequins as compared to normal static life size mannequins has prevented their adoption by the fashion industry.The goal of this project is to design, build and install a human like robot while minimizing power requirements and material; and at the same time maximize the functional purposes, such as interacting with humans. A life size interactive robotic mannequin prototype was designed and developed using low cost open source hardware and software, with an emphasis on using readily available, off the shelf construction material and hardware devices. A real life 3D body profile was created by using an innovative cardboard slice construction technique with the help of human body imaging and 3D CAD tools. Two computer engineering technology undergraduate students worked on this project under the guidance of faculty advisers, during the summer of 2016. The robotic mannequin prototype interacts with the customer by using a combination of low cost proximity and image sensors to detect its environment. The mannequin also features synthesized speech as well as head and arm movements to get customers attention and strikes various poses to show clothing styles. Additional enhancements are planned to allow the customers to interact with the mannequin through a web based user interface by using their smart phones wireless connectivity. It will also exhibit RGB LED based eye color change and LED bar graph lips synced with its speech. The mannequins design and development utilizes many different software tools for physical, electrical, computer hardware, software and network communication subsystems. Therefore, it can also be used for teaching those topics in several computer engineering technology program courses.

Determining Honey Bee Colony Health Using RF and Radar Techniques

Berkay Payal (University of Maine)

The sudden disappearance of honey bees, commonly referred to as Colony Collapse Disorder (CDD), is a problem that threatens agriculture, as up to 80% of the nation's crops are pollinated by honey bees. In CCD, worker bees suddenly disappear and do not come back to their hives, leaving behind the queen and immature bees. A remote sensing instrument is being developed as a tool to assist researchers and beekeepers to monitor bee hives. This instrument is based on a 5.8 GHz ISM band radar. The unit can be used to remotely detect vibrations in the bee hive due to bee activity, without opening the hive and thus disturbing the colony. When pointed to the bee hive entrance, the Doppler shift due to the ï¬‚ight of individual bees can be detected, as well as the wing beat of bees. An automated data acquisition system based on the Arduino Nano board was designed to operate with the radar instrument. The audio data was recorded at a 8Ks/s rate. The system was deployed in the field for a four week period during the summer of 2016. The collected data was processed in MATLAB. The frequency vs. time histogram was used to identify and quantify bee activities and the results are correlated with visual observations of bee researchers. Radar data shows that flying bees beat their wings between 200 to 250 beats-per-second. A vibration signature detected in the 100 to 150 Hz range was attributed to bees fanning the hive for cooling during the day and heating during the night through visual inspection.

MATCHMAKERS: A game for crowdsourcing solutions to an NP-hard problem

Christina Chung (University of Toronto)

The n-way matching problem considers finding correspondences between elements of multiple inputs. The problem has practical importance in software engineering, yet finding its optimal solution is NP-hard. Existing approximation algorithms are heuristic in nature and do not guarantee high quality matches. We report on a year-long effort of designing MATCHMAKERS, a game that uses collective human intelligence to solve the n-way matching problem. In the game, each input element is visually represented by a character. The player's goal is to form groups of friends between those that are similar, which corresponds to finding matches between input elements. In a short period of time, the game was played by 491 players. Game players were able to outperform automated solutions in one of three case studies, and came very close in the other two. Our work thus provides evidence towards the effectiveness of using human intelligence for solving complex computational problems. In this talk, we describe the game, discuss its results, and present a demo. Please attend our poster session for more details on the game's conceptual design and development process.

Multiple Robot Multiple Task Allocation

Tahiya Salam (University of Virginia)

Applications of mobile robots are expanding. Uses of theses robots are being seen in nearly all facets of society, including automated cleaning (e.g. the Roomba), self-driving cars, medical services, and military surveillance. While these robots are capable of performing tasks autonomously, fleets of these heterogeneous robots may be used to accomplish sets of tasks with time-extended assignment. Coordination amongst robots would be essentially in maximizing the efficiency of the robot by allowing favorable task distribution over groups of heterogeneous vehicles. Unlike single robot, single task, instantaneous assignment that can be solved in polynomial time, the problems of both instantaneous assignment and time-extended assignment for multiple robot multiple task allocation are much harder problems in combinatorial optimization. Multiple robot multiple task allocation explores heuristic approaches to optimizing time and energy expenditure over a heterogeneous fleet of robots.

Benefits of Autonomous UAS for Urban Search and Rescue

Sage Trudeau (Rensselaer Polytechnic Institute)

Despite their intense training and incredibly rapid response times, urban search and rescue teams are often unable to identify locations of surviving victims during disaster scenarios. They rely heavily on local tips and tend to resort to overlaying a grid on the disaster area and searching square by square. Search time could be reduced, and lives saved increased, if there was a better way to determine the location and density of survivors in disaster areas. The team proposes to use Commercial Off The Shelf (COTS) quadcopter and sensor technology in addition to open-source software to enable Unmanned Aerial Systems (UAS) to find and relay information about survivors. By integrating the capabilities of Stereoscopic Imaging, Light Detection And Ranging (LIDAR), Ultrasonic Ranging, and Thermal Imaging systems a UAS could be capable of autonomously locating entrances into a building, entering, and identifying warm bodies inside. A major challenge in the development of an autonomous UAS is fine tuning navigation and collision avoidance algorithms without risking the hardware. The UAS must be intelligent enough to avoid collisions during its search and place its own flight safety above all else. This ensures the information it gathers is able to be relayed from communication disadvantaged enclosures when a downlink is reestablished. The system would be capable of prioritizing the use of its downlink bandwidth for relaying survivor locations, while simultaneously storing mapping information for later download. The demonstration of this systems capability will show the identification of an entrance, in this case an open door, autonomous exploration into the building, identification of two people located inside, and a safe exit to report. This research directly benefits the efforts of first responders who include but are not limited to: fire fighters, police officers, paramedics, and the National Guard. First responders are often injured while on-duty, which can hinder search efforts and shorten their careers. To that end, this project has been designed to reduce the risk associated with urban search and rescue from collapsed or damaged buildings. Implementation of the UAS as a preliminary disaster surveillance device could inform first responders of feasible entrances, map building characteristics, and help avoid obstacles. With this information responders will be better equipped to handle the situation and triage appropriately. Minimizing risk and injury in disaster relief situations has the potential to increase the likelihood of victim discovery and protect the heroes in the field. This system will allow human users to optimize their search, spending more time saving lives and less time searching empty buildings.

New Technologies for Management of Core Body Temperature

Carlton Rice (University of Texas Austin)

Mammalian and avian species possess a highly optimized thermoregulatory system dependent on the ability to move heat between core and surface regions via the convection of blood. Glabrous areas of skin, primarily on the palms, soles, ears, and selected facial sites in humans, contain a dynamic and specialized vascular network with large-bore shunt vessels called arteriovenous anastomoses (AVAs). In situations requiring a conservation of core energy, AVAs tightly vasoconstrict, and in those requiring rejection of heat out of the body, they vasodilate. A primary site of this systematic control is the preoptic anterior hypothalamus (POAH). This study presents evidence of a parallel controller peripheral to the POAH lying along the spinal cord in humans, consistent with prior evidence in other mammals and avians. Thermally accessing the spinal controller simply and safely allows for POAH-independent core body temperature management. Specifically, this can be utilized to induce therapeutic hypothermia with potentially life-saving consequences for multiple medical conditions. Data demonstrates the efficacy of selective thermal stimulation (STS) to the spinal cord as a means to regulate blood flow to the AVAs on demand. STS can become a channel into a new generation of patient care.
