SINGAPORE UNIVERSITY OF TECHNOLOGY AND DESIGN

21 May – 22 July 2022

TOPICAL REPORT

ROBOTICS & AUTOMATION

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news

AUTOMATION

Automated platform for plasmid production

"Iasmids have extensive use in basic and applied biology. These small, circular DNA molecules are used by scientists to introduce new genes into a target organism. Well known for their applications in the production of therapeutic proteins like insulin, plasmids are broadly used in the large-scale production of many bioproducts."

Source: University of Illinois at Urbana-Champaign Institute for Sustainability, Energy, and Environment

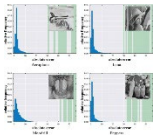
AUTONOMOUS VEHICLES

Technology helps self-driving cars learn from own 'memories'

"An autonomous vehicle is able to navigate city streets and other less-busy environments by recognizing pedestrians, other vehicles and potential obstacles through artificial intelligence. This is achieved with the help of artificial neural networks, which are trained to "see" the car's surroundings, mimicking the human visual perception system…Researchers at the Cornell Ann S. Bowers College of Computing and Information Science and the

academic

AUTOMATION



Automation of reversible steganographic coding with nonlinear discrete optimisation

"Authentication mechanisms are at the forefront of defending the world from various types of cybercrime. Steganography can serve as an authentication solution through the use of a digital signature embedded in a carrier object to ensure the integrity of the object and simultaneously lighten the burden of metadata management. Nevertheless, despite being generally imperceptible to human sensory systems, any degree of steganographic distortion might be inadmissible in fidelity-sensitive situations such as forensic science, legal proceedings, medical diagnosis and military reconnaissance. This has led to the development of reversible steganography. A fundamental element of reversible steganography is predictive analytics, for which powerful neural network models have been effectively deployed."

Source: Taylor & Francis

A Smart Home Automation System

"Necessity is the mother of invention. Today's world is all about technology and people inventing new technologies to make their life easy. With the help of technology, we are able to design a product that is

reports

AUTOMATION

Industrial Automation Global Market Report 2022

"The global industrial automation market is expected to grow from $164.74 billion in 2021 to $178.88 billion in 2022 at a compound annual growth rate (CAGR) of 8.6%. The industrial automation market is expected to grow to $250.77 billion in 2026 at a CAGR of 8.8%.

The industrial automation market consists of sales of industrial automation products and services by entities (organizations, sole proprietors, partnerships) that are used to control and monitor a process, machine, or device in a computerized manner that will fulfill repetitive functions or tasks. They are designed to operate automatically to reduce and improve human work in the industry. They are operated using logical programming commands and powerful machinery.

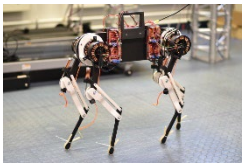
The main components of industrial automation are industrial robots, human-machine interfaces (HMI), industrial sensors, control valves, and other components. Industrial automation uses HMIs to monitor machinery to make sure it's working properly and also, they are helpful in the maintenance of the machinery in the industries. They use various control systems such as supervisory control and data acquisition (SCADA), distributed control system (DCS), programmable logic controller (PLC),

College of Engineering have produced three concurrent research papers with the goal of overcoming this limitation by providing the car with the ability to create "memories" of previous experiences and use them in future navigation."
Source: Cornell University

On the road to cleaner, greener, and faster driving

"In a new study, MIT researchers demonstrate a machine-learning approach that can learn to control a fleet of autonomous vehicles as they approach and travel through a signalized intersection in a way that keeps traffic flowing smoothly.
Using simulations, they found that their approach reduces fuel consumption and emissions while improving average vehicle speed. The technique gets the best results if all cars on the road are autonomous, but even if only 25 percent use their control algorithm, it still leads to substantial fuel and emissions benefits."
Source: Massachusetts Institute of Technology

ROBOTICS RESEARCH



Robot dog learns to walk in one hour

"Researchers at the Max Planck Institute for Intelligent Systems (MPI-IS) in Stuttgart conducted a research study to find out how animals learn to walk and learn from stumbling. They built a four-legged, dog-sized robot, that helped them figure out the details"As engineers and roboticists, we sought the answer by building a robot that features reflexes just like an animal and learns from mistakes," says Felix Ruppert, a former doctoral student in the Dynamic Locomotion research group at MPI-IS. "If an animal stumbles, is that a mistake? Not if it happens once. But if it stumbles frequently, it gives us a measure of how well the robot walks."
Felix Ruppert is first author of "Learning Plastic Matching of Robot Dynamics in Closed-loop Central Pattern Generators", which was published July 18, 2022 in the prestigious journal Nature Machine Intelligence."
Source: Max Planck Institute for Intelligent Systems

Robots learn household tasks by watching humans

"The robot watched as Shikhar Bahl opened the refrigerator door. It recorded his movements, the swing of the door, the location of the fridge beneficial for society and give a great contribution in term of development. From last many year many new inventions have done and smart home is one of them. The concept of smart home is about the home which works automatically. The smart home has smart appliances such as air-conditioners, fans, bulbs, television, a security system, and doors. In this paper, an Arduino and Bluetooth module-based system has been designed. This system is fully programmed with an automated and easy to used automatic controller."
Source: Elsevier

A Conversational Agent for Creating Flexible Daily Automation

"The spread of sensors and intelligent devices of the Internet of Things and their integration in daily environments are changing the way we interact with some of the most common objects in everyday life. Therefore, there is an evident need to provide non-expert users with the ability to customize in a simple but effective way the behaviour of these devices based on their preferences and habits. This paper presents RuleBot, a conversational agent that uses machine learning and natural language processing techniques to allow end users to create automations according to a flexible implementation of the trigger-action paradigm, and thereby customize the behaviour of devices and sensors using natural language. In particular, the paper describes the design and implementation of RuleBot, and reports on a user test and lessons learnt."
Source: ACM Digital Library

Inventory automation practices and productivity: a study on steel manufacturing firms

"The purpose of this study is to explore the relationship between inventory automation practices (IAP) and the productivity of steel manufacturing firms. The study also explores the mediation effect of knowledge of IAPs on the relationship between IAP and firms' productivity (FP). Study based on data, collected from 287-key officials of three manufacturing firms of Odisha, India using a structured questionnaire. SPSS and Amos software were used for data analysis. Data were processed through the test of validity and reliability and subsequently, structural equation modelling (SEM) was applied to test the hypotheses. The research findings revealed that IAP has a significant positive impact on the productivity of manufacturing firms. It is also found that knowledge Manufacturing Execution System (MES), component lifecycle management (PLM), enterprise resource planning (ERP), and human-machine interface (HMI) that are used by aerospace and defense, automotive, healthcare, energy and utilities, manufacturing, oil and gas, mining, transportation, and other industries."
Source: Automation.com

2022 Trends: Automation Accelerates

"2022 is the year automation comes into its own. Businesses are ready, the technology is falling into place, and all that's left is for you to jump in and start reaping the benefits. But, before making any investment, it's good to know where we are today—and what's speeding around the bend.
Recently, UiPath interviewed a variety of experts—analysts, partners, customers, our own team—and distilled their thoughts down to 10 key trends that will define the near (and far) future of automation.
Download "Automation Accelerates" to get the full detail on these trends, along with advice for helping your business make the most of each. Key topics include:

- **Innovations in automation technology,**

including task-based workflows, semantic automation, and RPA-plus platforms

- **Advances in automation adoption,**

from CIOs to CSOs to HR to CoEs

- **Strategies for automation optimization,**

with step-by-step processes, things to watch out for, and the goals you should be setting."
Source: UIPath

Stonebranch 2022 Global State of IT Automation Report

"Developed in partnership with the IEEE Computer Society, the 2022 Global State of IT Automation report identifies the latest trends, best practices, and benchmarks for automation and orchestration across cloud, data pipelines, IT operations, self-service enablement, and more. Key findings include:

- **Multi-cloud environments are the norm.** 92% of enterprises use more than two public cloud service providers and 91% automate their data transfers between those providers.
- **Integration is key.** 78% of respondents report that they change data sources at least quarterly, if not more often, to

and more, analyzing this data and readying itself to mimic what Bahl had done.
It failed at first, missing the handle completely at times, grabbing it in the wrong spot or pulling it incorrectly. But after a few hours of practice, the robot succeeded and opened the door.
"Imitation is a great way to learn," said Bahl, a Ph.D. student at the Robotics Institute (RI) in Carnegie Mellon University's School of Computer Science. "Having robots actually learn from directly watching humans remains an unsolved problem in the field, but this work takes a significant step in enabling that ability."
Source: Carnegie Mellon University

A robot learns to imagine itself

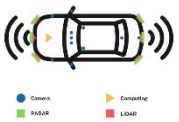
"As every athletic or fashion-conscious person knows, our body image is not always accurate or realistic, but it's an important piece of information that determines how we function in the world. When you get dressed or play ball, your brain is constantly planning ahead so that you can move your body without bumping, tripping, or falling over.
We humans acquire our body-model as infants, and robots are following suit. A Columbia Engineering team announced today they have created a robot that—for the first time—is able to learn a model of its entire body from scratch, without any human assistance. In a new study published by Science Robotics, the researchers demonstrate how their robot created a kinematic model of itself, and then used its self-model to plan motion, reach goals, and avoid obstacles in a variety of situations. It even automatically recognized and then compensated for damage to its body."
Source: Columbia University School of Engineering and Applied Science

'Fake' data helps robots learn the ropes faster

"In a step toward robots that can learn on the fly like humans do, a new approach expands training data sets for robots that work with soft objects like ropes and fabrics, or in cluttered environments. Developed by robotics researchers at the University of Michigan, it could cut learning time for new materials and environments down to a few hours rather than a week or two. In simulations, the expanded training data set improved the success rate of a robot looping a rope around an engine block by more than 40% and nearly doubled the successes of a physical robot for a similar task."
Source: University of Michigan

of IAP is partially mediating the above relationship."
Source: Inder Science

AUTONOMOUS VEHICLES



A Review on Autonomous Vehicles: Progress, Methods and Challenges

"Vehicular technology has recently gained increasing popularity, and autonomous driving is a hot topic. To achieve safe and reliable intelligent transportation systems, accurate positioning technologies need to be built to factor in the different types of uncertainties such as pedestrian behavior, random objects, and types of roads and their settings. In this work, we look into the other domains and technologies required to build an autonomous vehicle and conduct a relevant literature analysis. In this work, we look into the current state of research and development in environment detection, pedestrian detection, path planning, motion control, and vehicle cybersecurity for autonomous vehicles. We aim to study the different proposed technologies and compare their approaches. For a car to become full."
Source: MDPI

Legislation Supports Autonomous Vehicles But Not Connected Ones

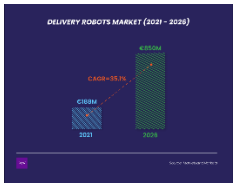
"It is inspiring to notice that legislation that helps incorporate autonomous vehicles on our roads in the near future is moving forward. The National Highway Traffic Safety Administration (NHTSA), which is part of the U.S. Department of Transportation (USDoT), has integrated automated vehicles into the existing safety standards such that the text in the standards do not rely on the existence of steering wheels and driver's seats, which may not exist in fully autonomous vehicles. In addition, the NHTSA has incorporated lane-keeping support, pedestrian automatic emergency braking, blind spot detection, and blind spot intervention into its Five-Star Safety Ratings program. Such driver-assistance technologies are the first steps toward fully autonomous vehicles but, more importantly, toward safer ones. Developing safer vehicles requires significant investments, so it is important that the legislation provide a framework that is predictable, reducing the risk of long-term commitment."
Source: IEEE Xplore

connect ever-changing set of analytics tools, source systems, and storage technologies.

- **Service orchestration and automation platforms (SOAP) have grown in popularity.** Only two years after Gartner created the category, 43% of enterprises plan to invest in SOAP by the end of 2022."

Source: Stonebranch

ROBOTICS INDUSTRY



Top Emerging Robotics Trends in 2022

"The use of several modern technology combinations to create a highly flexible, self-adapting manufacturing capacity known as the "smart factory."
For instance, businesses like manufacturing and distribution will develop greater intelligence as robots do. Assembly lines will benefit from industrial robots and automated solutions, and smart factories will become the norm.
As a result, we should anticipate quicker, more effective, and more precise processes with fewer errors. Robots and autonomous mobile robots (AMRs) will interact in the future, necessitating less upkeep and human involvement.
Smart factories may achieve new levels of efficiency and flexibility by connecting various processes, information streams, and stakeholders (frontline workers, planners, etc.) in a coordinated manner. Digital factory and intelligent factory initiatives are some names for innovative industrial projects."
Source: MarkTechPost

Global Industrial Robotics Market Report (2022 to 2030)

"The Global Industrial Robotics Market size was valued at USD 32.32 billion in 2021 and is predicted to reach USD 88.55 billion by 2030 with a CAGR of 12.1% from 2022-2030.
Industrial robots play a vital role in automating manufacturing processes across different industries. They can perform different industrial tasks such as loading, packaging, labelling, product inspection, and shifting among others. Industrial robot increases productivity and profitability of organizations by eliminating labour-intensive activities with high degree of accuracy and efficiency. Moreover, they can work

Tiny fish-shaped robot 'swims' around picking up microplastics

"The researchers linked β-cyclodextrin molecules to sulfonated graphene, creating composite nanosheets. Then solutions of the nanosheets were incorporated with different concentrations into polyurethane latex mixtures. A layer-by-layer assembly method created an ordered concentration gradient of the nanocomposites through the material from which the team formed a tiny fish robot that was 15-mm (about half-an-inch) long. Rapidly turning a near-infrared light laser on and off at a fish's tail caused it to flap, propelling the robot forward. The robot could move 2.67 body lengths per second — a speed that's faster than previously reported for other soft swimming robots and that is about the same speed as active phytoplankton moving in water. The researchers showed that the swimming fish robot could repeatedly adsorb nearby polystyrene microplastics and transport them elsewhere. The material could also heal itself after being cut, still maintaining its ability to adsorb microplastics. Because of the durability and speed of the fish robot, the researchers say that it could be used for monitoring microplastics and other pollutants in harsh aquatic environments."

Source: American Chemical Society

Supernumerary virtual robotic arms can feel like part of our body

"Research teams at the University of Tokyo, Keio University and Toyohashi University of Technology in Japan have developed a virtual robotic limb system which can be operated by users' feet in a virtual environment as extra, or supernumerary, limbs. After training, users reported feeling like the virtual robotic arms had become part of their own body. This study focused on the perceptual changes of the participants, understanding of which can contribute to designing real physical robotic supernumerary limb systems that people can use naturally and freely just like our own bodies.

What would you do with an extra arm, or if like Spider-Man's nemesis Doctor Octopus, you could have an extra four? Research into extra, or supernumerary, robotic limbs looks at how we might adapt, mentally and physically, to having additional limbs added to our bodies."

Source: University of Tokyo

ROBOT-HUMAN INTERACTIONS

6G for Vehicle-to-Everything (V2X) Communications: Enabling Technologies, Challenges, and Opportunities

"We are on the cusp of a new era of connected autonomous vehicles with unprecedented user experiences, tremendously improved road safety and air quality, highly diverse transportation environments and use cases, and a plethora of advanced applications. Realizing this grand vision requires a significantly enhanced vehicle-to-everything (V2X) communication network that should be extremely intelligent and capable of concurrently supporting hyperfast, ultrareliable, and low-latency massive information exchange. It is anticipated that the sixth-generation (6G) communication systems will fulfill these requirements of the next-generation V2X. In this article, we outline a series of key enabling technologies from a range of domains, such as new materials, algorithms, and system architectures."

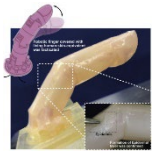
Source: IEEE Xplore

Modeling Explanations in Autonomous Vehicles

"This research approach deals with rational methods for generating explanations provided by autonomous vehicles. The first part concerns a new model for generating explanation content. In the second part, we describe a method for providing explanations at time instants demanding less cognitive workload using game theory."

Source: Springer Link

SOFT ROBOTICS



Living skin on a robot

"Humanoids are robots created with human forms or characteristics; these robots also have the potential to seamlessly interact with human beings. By replicating the appearances and functions (e.g., self-healing) of human beings, humanoids have the potential to establish more harmonic and natural human-robot interactions. Here, we propose the use of skin equivalent, a living skin model consisting of cells and extracellular matrix, as a human-like and self-healing coverage material for robots. We fabricated a three-joint robotic finger covered with skin equivalent by developing a method to cover three-dimensional objects with skin equivalent. Furthermore, inspired by the medical in hazardous environment such as high-pressure or vacuum chambers, and areas where there are explosions, infections, and radiation among others. They are widely used in automobiles and heavy engineering industries.

The growth in the manufacturing and electronics industries is one of the major factors fuelling the industrial robotics market growth. Also, product manufacturers are adopting robots to automate some of the repetitive processes.

According to data released in Oct, 2019, by the Robot Industry Association, more than 250,000 industrial robots had been adopted in the United States alone, giving an evaluation of the penetration rate of industrial robotics. Also, the newest industrial revolution called Industry 4.0, has raised the evolution of new technologies, like AI-enabled robots, and collaborative robots that have empowered industries to use robots to streamline industrial processes."

Source: Globe NewsWire

Innovations In 3d Safety Radars, Vertical Farming, Miniature Robots, Wearable Sweat Sensors & Cancer Diagnostic Devices

"This edition of the Inside R&D TOE features information on the use of intelligent platform enabling real-time monitoring of vital parameters in aeroponic and hydroponic vertical farming systems. The TOE also covers innovations based on the use of 3D radar sensors enhancing worker safety within the manufacturing industry while complying with international standards. The other focal point of the TOE is the use of carbon capture mechanisms along with microbial gas fermentation for the sustainable production of mono-ethylene glycol that is used in a wide range of high end applications. The TOE additionally provides insights on the use of remote controlled miniaturized robots for surgeries and electronics manufacturing. The TOE provides latest innovations in the use of diagnostic devices based on high-resolution wave imaging for the rapid detection of skin cancer, wearable sweat sensors with ultrasensitive detection limits to provide cost effective home diagnostic services and the use of inexpensive surface enhanced Raman scattering sensors for the detection of pesticides in fruits. Inside R&D Technology Opportunity Engine covers global innovations in virtually all technology areas. We provide intelligence and insights on innovations spanning a wide variety of industry areas, including automation, electronics, sensors, information and communication

Who's really in control?

Researchers at the Department of Systems Innovation at Osaka University tested the psychological impact of remotely operating certain semi-autonomous robots on humans. These "telepresence" robots are designed to transmit the human voice and mannerisms as a way of alleviating labor shortages and minimizing commuting costs. For example, a human operator may control the voice, while the body movements are handled automatically by a computer. "Semi-autonomous robots have shown potential for practical applications in which a robot's autonomous actions and human teleoperation are jointly used to accomplish difficult tasks. A system that combines the 'intentions' of different agents, such as an algorithm and a human user, that are collectively used to operate a single robot is called collaborative control," first author Tomonori Kubota says."
Source: Osaka University

Human-like robots may be perceived as having mental states

"When robots appear to engage with people and display human-like emotions, people may perceive them as capable of "thinking," or acting on their own beliefs and desires rather than their programs, according to research published by the American Psychological Association. "The relationship between anthropomorphic shape, human-like behavior and the tendency to attribute independent thought and intentional behavior to robots is yet to be understood," said study author Agnieszka Wykowska, PhD, a principal investigator at the Italian Institute of Technology. "As artificial intelligence increasingly becomes a part of our lives, it is important to understand how interacting with a robot that displays human-like behaviors might induce higher likelihood of attribution of intentional agency to the robot."
Source: American Psychological Association

Humans in the loop help robots find their way

"Just like us, robots can't see through walls. Sometimes they need a little help to get where they're going.
Engineers at Rice University have developed a method that allows humans to help robots "see" their environments and carry out tasks. The strategy called Bayesian Learning IN the Dark -- BLIND, for short -- is a novel solution to the long-standing problem of motion planning for robots that treatment of deeply burned skin using grafted hydrogels, we demonstrated wound repair of a dermis equivalent covering a robotic finger by culturing the wounded tissue grafted with a collagen sheet. With the above results, this research shows the potential of using skin equivalent as human-like and self-healing coverage material for robots."
Source: Cell Press

Using R-Functions to Control the Shape of Soft Robots

"In this letter, we introduce a new approach for soft robot shape formation and morphing using approximate distance fields. The method uses concepts from constructive solid geometry, R-functions, to construct an approximate distance function to the boundary of a domain in Rd. The gradients of the R-functions can then be used to generate control algorithms for shape formation tasks for soft robots. By construction, R-functions are smooth and convex everywhere, possess precise differential properties, and easily extend from R2 to R3 if needed. Furthermore, R-function theory provides a straightforward method to creating composite distance functions for any desired shape by combining subsets of distance functions."
Source: IEEE Xplore

Development of a Soft Robotic Bending Actuator Based on a Novel Sulfonated Polyvinyl Chloride–Phosphotungstic Acid Ionic Polymer–Metal Composite (IPMC) Membrane

"This work presents the development of a cost-effective electric-stimulus-responsive bending actuator based on a sulfonated polyvinyl chloride (SPVC)–phosphotungstic acid (PTA) ionic polymer–metal composite (IPMC), using a simple solution-casting method followed by chemical reduction of platinum (Pt) ions as an electrode. The characterizations of the prepared IPMC were performed using Fourier-transform infrared (FTIR) spectroscopy, Scanning electron microscopy (SEM), X-ray diffraction (XRD) techniques, Thermogravimetric analysis (TGA), and Energy-dispersive X-ray (EDX) analysis. Excellent ion-exchange capacity (IEC) and proton conductivity (PC), with values of ca. 1.98 meq·g−1 and ca. 1.6 mS·cm−1, respectively, were observed."
Source: MDPI

Robust and Decoupled Position and Stiffness Control for Electrically-Driven Articulated Soft Robots

technologies, manufacturing, health, wellness, medical devices, pharma, biotechnology, materials, coatings, renewable fuels, automotive, power systems, sustainable energy solutions and innovations that contribute to a cleaner and greener environment."
Source: Frost & Sullivan

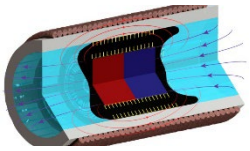
work in environments where not everything is clearly visible all the time."
Source: Rice University

SUSTAINABLE DEVELOPMENT

Can robotics help us achieve sustainable development?

"An international team of scientists, led by the University of Leeds, have assessed how robotics and autonomous systems might facilitate or impede the delivery of the UN Sustainable Development Goals.
Their findings identify key oppoyrtunities and key threats that need to be considered while developing, deploying and governing robotics and autonomous systems.
The key opportunities robotics and autonomous systems present are through autonomous task completion, supporting human activities, fostering innovation, enhancing remote access and improving monitoring."
Source: University of Leeds

SOFT ROBOTICS



Deformable pump gives soft robots a heart

"The Tin Man didn't have one. The Grinch's was three sizes too small. And for soft robots, the electronically powered pumps that function as their "hearts" are so bulky and rigid, they must be decoupled from the robot's body – a separation that can leak energy and render the bots less efficient.
Now, a collaboration between Cornell researchers and the U.S. Army Research Laboratory has leveraged hydrodynamic and magnetic forces to drive a rubbery, deformable pump that can provide soft robots with a circulatory system, in effect mimicking the biology of animals."
Source: Cornell Univeristy

ARTIFICIAL INTELLIGENCE

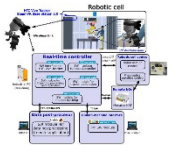
Using AI to train teams of robots to work together

"The control of articulated soft robots, i.e. robots with flexible joints and rigid links, presents a challenge due to their intrinsic elastic elements and nonlinear force-deflection dependency. This letter first proposes a discrete-time delayed unknown input-state observer based on a nominal robot model that reconstructs the total torque disturbance vector, resulting from the imperfect knowledge of the elastic torque characteristic, external torques, and other model uncertainties. Then, it introduces a robust controller, that actively compensates for the estimated uncertainty and allows bounded stability for the tracking of independent link position and joint stiffness reference signals."
Source: IEEE Xplore

SSVEP-Based Brain Computer Interface Controlled Soft Robotic Glove for Post-Stroke Hand Function Rehabilitation

"Soft robotic glove with brain computer interfaces (BCI) control has been used for post-stroke hand function rehabilitation. Motor imagery (MI) based BCI with robotic aided devices has been demonstrated as an effective neural rehabilitation tool to improve post-stroke hand function. It is necessary for a user of MI-BCI to receive a long time training, while the user usually suffers unsuccessful and unsatisfying results in the beginning. To propose another non-invasive BCI paradigm rather than MI-BCI, steady-state visually evoked potentials (SSVEP) based BCI was proposed as user intension detection to trigger the soft robotic glove for post-stroke hand function rehabilitation. Thirty post-stroke patients with impaired hand function were randomly and equally divided into three groups to receive conventional, robotic, and BCI-robotic therapy in this randomized control trial (RCT)."
Source: IEEE Xplore

INDUSTRIAL ROBOTS



Affordable Motion Tracking System for Intuitive Programming of Industrial Robots

"The paper deals with a lead-through method of programming for industrial robots. The goal is to automatically reproduce 6DoF trajectories of a tool wielded by a human operator demonstrating a motion task. We present a novel motion-tracking

"Tran and his collaborators used machine learning to solve this problem by creating a utility function that tells the agent when it is doing something useful or good for the team.
"With team goals, it's hard to know who contributed to the win," he said. "We developed a machine learning technique that allows us to identify when an individual agent contributes to the global team objective. If you look at it in terms of sports, one soccer player may score, but we also want to know about actions by other teammates that led to the goal, like assists. It's hard to understand these delayed effects."
Watch a video of Huy Tran demonstrating related research using deep reinforcement learning to help robots evaluate their next move in Capture the Flag.
Source: University of Illinois Grainger College of Engineering

Engineers devise a recipe for improving any autonomous robotic system

"Now, MIT engineers have developed a general design tool for roboticists to use as a sort of automated recipe for success. The team has devised an optimization code that can be applied to simulations of virtually any autonomous robotic system and can be used to automatically identify how and where to tweak a system to improve a robot's performance.
The team showed that the tool was able to quickly improve the performance of two very different autonomous systems: one in which a robot navigated a path between two obstacles, and another in which a pair of robots worked together to move a heavy box."
Source: Massachusetts Institute of Technology

Robot overcomes uncertainty to retrieve buried objects

"MIT researchers previously demonstrated a robotic arm that combines visual information and radio frequency (RF) signals to find hidden objects that were tagged with RFID tags (which reflect signals sent by an antenna). Building off that work, they have now developed a new system that can efficiently retrieve any object buried in a pile. As long as some items in the pile have RFID tags, the target item does not need to be tagged for the system to recover it.
The algorithms behind the system, known as FuseBot, reason about the probable location and orientation of objects under the pile. Then FuseBot finds the most efficient way to remove obstructing objects and extract the target item. This reasoning enabled FuseBot to find more hidden items

system built around the HTC Vive pose estimation system. Our solution allows complete automation of the robot teaching process. Specific algorithmic issues of system calibration and motion data post-processing are also discussed, constituting the paper's theoretical contribution. The motion tracking system is successfully deployed in a pilot application of robot-assisted spray painting."
Source: MDPI

Performance and Stability Analysis of Industrial Robot Manipulator

"Human–robot interaction (HRI) is essential in industry to the demands of technical feasibility and productivity gains in terms of quality, accuracy, dependability, and adaptability. Developing a human-like behaviour control method is one of the most difficult elements of robotics research. The dynamic nature of human responses complicates the task of a robot controller even further. This paper focuses on the development of an optimum controller for controlling a human-like robotic arm in industrial applications. The conventional technique of tuning of a PID controller is inefficient, time consuming, and has limited capabilities. A Genetic Algorithm (GA) is used to optimise the gain parameters of PID controller, with an objective function based on the Mean Square Error (MSE) as the performance index being minimised."
Source: Springer Link

Precision measurement and compensation of kinematic errors for industrial robots using artifact and machine learning

"Industrial robots are widely used in various areas owing to their greater degrees of freedom (DOFs) and larger operation space compared with traditional frame movement systems involving sliding and rotational stages. However, the geometrical transfer of joint kinematic errors and the relatively weak rigidity of industrial robots compared with frame movement systems decrease their absolute kinematic accuracy, thereby limiting their further application in ultra-precision manufacturing. This imposes a stringent requirement for improving the absolute kinematic accuracy of industrial robots in terms of the position and orientation of the robot arm end. Current measurement and compensation methods for industrial robots either require expensive measuring systems, producing positioning or orientation errors, or offer low measurement accuracy."
Source: Springer Link

than a state-of-the-art robotics system, in half the time."
Source: Massachusetts Institute of Technology

Automating Renal Access in Kidney Stone Surgery Using AI-Enabled Surgical Robot

"Percutaneous nephrolithotomy (PCNL) is an efficient surgical intervention for removing large kidney stones. However, it is a challenging procedure that requires years of training to perform. To meet the need for quick skill-building, a group of scientists from the Nagoya City University, developed and trialed an artificial intelligence (AI)-enabled robotic device for assisting surgeons in PCNL. Its notable features include ease of use and better accuracy in creating renal access."
Source: Nagoya City University

Intelligent Fault Diagnosis of Industrial Robot Based on Multiclass Mahalanobis-Taguchi System for Imbalanced Data

"One of the biggest challenges for the fault diagnosis research of industrial robots is that the normal data is far more than the fault data; that is, the data is imbalanced. The traditional diagnosis approaches of industrial robots are more biased toward the majority categories, which makes the diagnosis accuracy of the minority categories decrease. To solve the imbalanced problem, the traditional algorithm is improved by using cost-sensitive learning, single-class learning and other approaches. However, these algorithms also have a series of problems. For instance, it is difficult to estimate the true misclassification cost, overfitting, and long computation time. Therefore, a fault diagnosis approach for industrial robots, based on the Multiclass Mahalanobis-Taguchi system (MMTS), is proposed in this article."
Source: MDPI

SOCIAL ROBOTS

Designing Sound for Social Robots: Candidate Design Principles

"How can we use sound and music to create rich and engaging human-robot interactions? A growing body of HRI research explores the many ways in which sound affects human-robot interactions and although some studies conclude with tentative design recommendations, there are, to our knowledge, no generalised design recommendations for the robot sound design process. We address this gap by first investigating sound design frameworks in the domains of product sound design and film sound to see whether practices and concepts from these areas contain actionable insights for the creation of robot sound. We then present three case studies, detailed examinations of the sound design of commercial social robots Cozmo and Vector, Jibo, and Kuri, facilitated by expert interviews with the robots' sound designers."
Source: Springer Link

Diversity-aware social robots meet people: beyond context-aware embodied AI

"The article introduces the concept of "diversity-aware" robotics and discusses the need to develop computational models to embed robots with diversity-awareness: that is, robots capable of adapting and re-configuring their behavior to recognize, respect, and value the uniqueness of the person they interact with to promote inclusion regardless of their age, race, gender, cognitive or physical capabilities, etc. Finally, the article discusses possible technical solutions based on Ontologies and Bayesian Networks, starting from previous experience with culturally competent robots."
Source: Cornell University

Social Robots: The Friend of the Future or Mechanical Mistake?

"Isolation can manifest anywhere a person chooses to age. It is detrimental to mental health and is compared to smoking cigarettes and obesity [1]. While interaction with another human being is preferable, sometimes, individuals are not able to do this. Older adults who live far from their families, individuals inside assisted living facilities during the COVID-19 pandemic, and individuals who have a limited social circle due to retirement or loss of friends may all feel isolated [2]. Cognitive decline can cause isolation in older adults as well [3]. Social robotics is poised to impact society by addressing isolation and providing companionship for these individuals by augmenting human interaction when none is available."
Source: IEEE Xplore

Towards Culture-Aware Co-Speech Gestures for Social Robots

"Embedding social robots with the capability of accompanying their sentences with natural gestures may be the key to increasing their acceptability and their usage in real contexts. However, the definition of natural communicative gestures may not be trivial, since it strictly depends on the culture of the person interacting with the robot. The proposed work investigates the possibility of generating culture-dependent communicative gestures, by proposing an integrated approach based on a custom dataset composed exclusively of persons belonging to the same culture, an adversarial generation module based on speech audio features, a voice conversion module to manage the multi-person dataset, and a 2D-to-3D mapping module for generating three-dimensional gestures."
Source: Springer Link

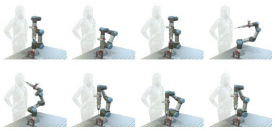
AUGMENTED REALITY

Designing a Shared Workspace for Learning Using Augmented Reality and Social Robots

"Augmented Reality (AR) is a novel technology utilized for merging real and virtual elements, enhancing the physical world. Developing AR applications in Robotics has been of interest in recent years. The current paper proposes a shared workspace for learning using Augmented Reality. The objective is to implement this approach using robots, not to execute collaborative robotic tasks but to establish a collaborative learning environment among students and social robots. We use an Augmented Reality application to superimpose virtual objects to the users' real world, aiming to achieve joint attention at a common point of interest among humans and social robots. The social robot perceives what occurs in the augmented environment and interacts (e.g., sharing information, making comments and gestures, giving constructive feedback to the users, etc.), intending to support humans to achieve the learning goals of the activities."

Source: Springer Link

COLLABORATIVE ROBOTS



Intelligent Sampling of Anterior Human Nasal Swabs using a Collaborative Robotic Arm

"Advanced robotics does not always have to be associated with Industry 4.0, but can also be applied, for example, in the Smart Hospital concept. Developments in this field have been driven by the coronavirus disease (COVID-19), and any improvement in the work of medical staff is welcome. In this paper, an experimental robotic platform was designed and implemented whose main function is the swabbing samples from the nasal vestibule. The robotic platform represents a complete integration of software and hardware, where the operator has access to a web-based application and can control a number of functions."

Source: MENDEL

Wire Harness Assembly Process Supported by Collaborative Robots: Literature Review and Call for R&D

"The wire harness assembly process is a complicated manufacturing activity, which is becoming more complex because of the evolving nature of mechatronic and electronic products that require more connectors, sensors, controllers, communication networking, etc. Furthermore, the demand for wire harnesses continues to grow in all industries worldwide as the majority of equipment, appliances, machinery, vehicles, etc., are becoming "smart" (i.e., more mechatronic or electronic). Moreover, most of the wire harness assembly process tasks are done manually, and most of these are considered non-ergonomic for human assembly workers. Hence, the wire harness manufacturing industry is faced with the challenge of increasing productivity while improving the occupational health of its human assembly workers."

Source: MDPI

Manipulability Optimization of a Rehabilitative Collaborative Robotic System

"The use of collaborative robots (or cobots) in rehabilitation therapies is aimed at assisting and shortening the patient's recovery after neurological injuries. Cobots are inherently safe when interacting with humans and can be programmed in different working modalities based on the patient's needs and the level of the injury. This study presents a design optimization of a robotic system for upper limb rehabilitation based on the manipulability ellipsoid method. The human–robot system is modeled as a closed kinematic chain in which the human hand grasps a handle attached to the robot's end effector."

Source: MDPI

3D PRINTING TECHNOLOGY

Design and printing of proprioceptive three-dimensional architected robotic metamaterials

"Advances in additive manufacturing techniques have enabled the creation of stimuli-responsive materials with designed three-dimensional (3D) architectures. Unlike biological systems in which functions such as sensing, actuation, and

control are closely integrated, few architected materials have comparable system complexity. We report a design and manufacturing route to create a class of robotic metamaterials capable of motion with multiple degrees of freedom, amplification of strain in a prescribed direction in response to an electric field (and vice versa), and thus, programmed motions with self-sensing and feedback control. These robotic metamaterials consist of networks of piezoelectric, conductive, and structural elements interwoven into a designed 3D lattice."
Source: Science