DesignNews

A LOOK AT THE TECHNOLOGY DRIVING NEW ROBOTS

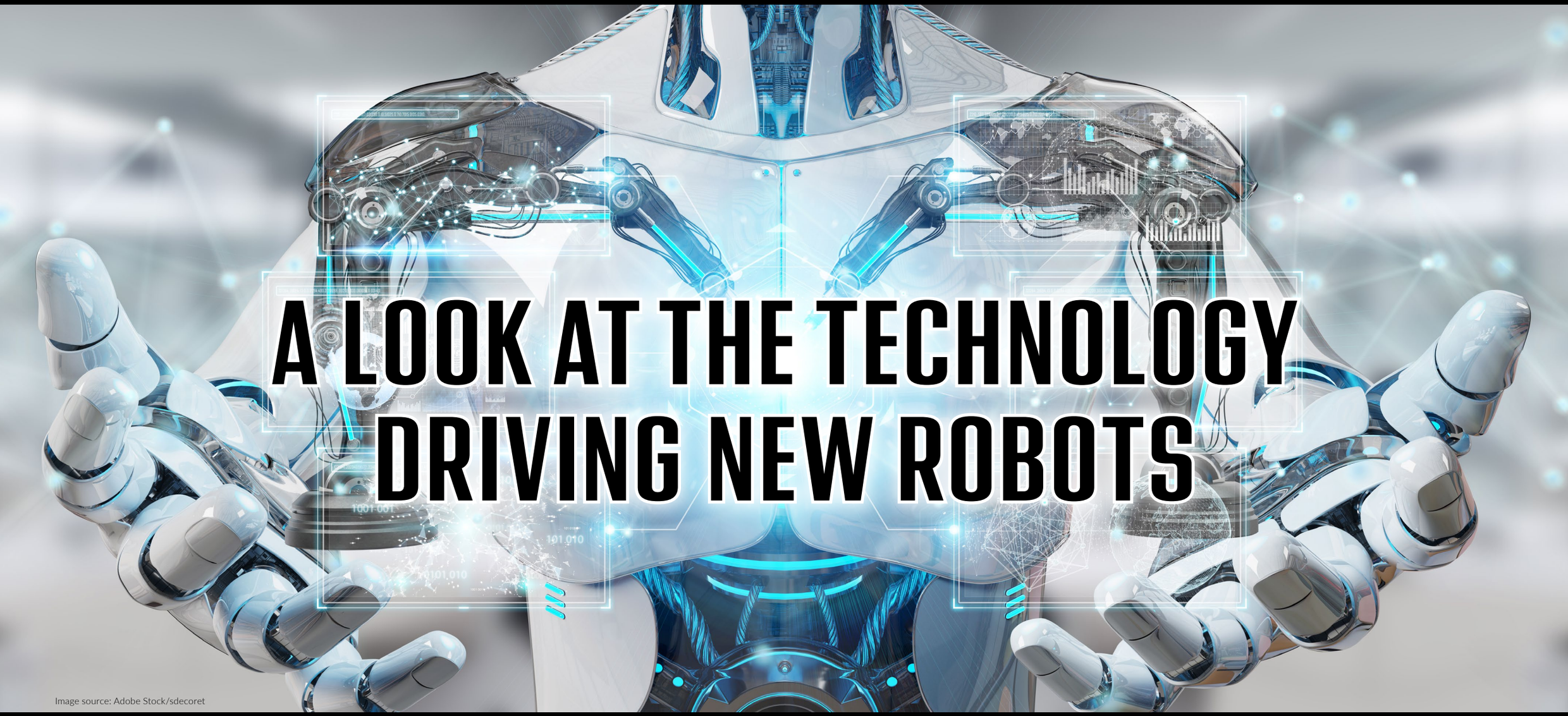


Image source: Adobe Stock/sdecoret

SPONSORED BY maxon

TABLE OF CONTENTS

The New Isaac Sim Makes Smarter Robots Using Smarter Simulation 3

Tech Disruptors: The Robot Enters the Body 6

Differences between AGV and AMR 10

It Takes a Village to Automate a Plant 13

Robot Democratization: A Machine for Every Manufacturer 16

Intelligent Transport Systems Enhance Human-Robot Collaboration 20

SPONSORED BY maxon

Image source: Adobe Stock/phonlamaiphoto

The New Isaac Sim Makes Smarter Robots Using Smarter Simulation

The newest release of Nvidia Isaac Sim – 2020.1 – introduces new simulation tools for developing smarter collaborative robots.

BY CHRIS WILTZ

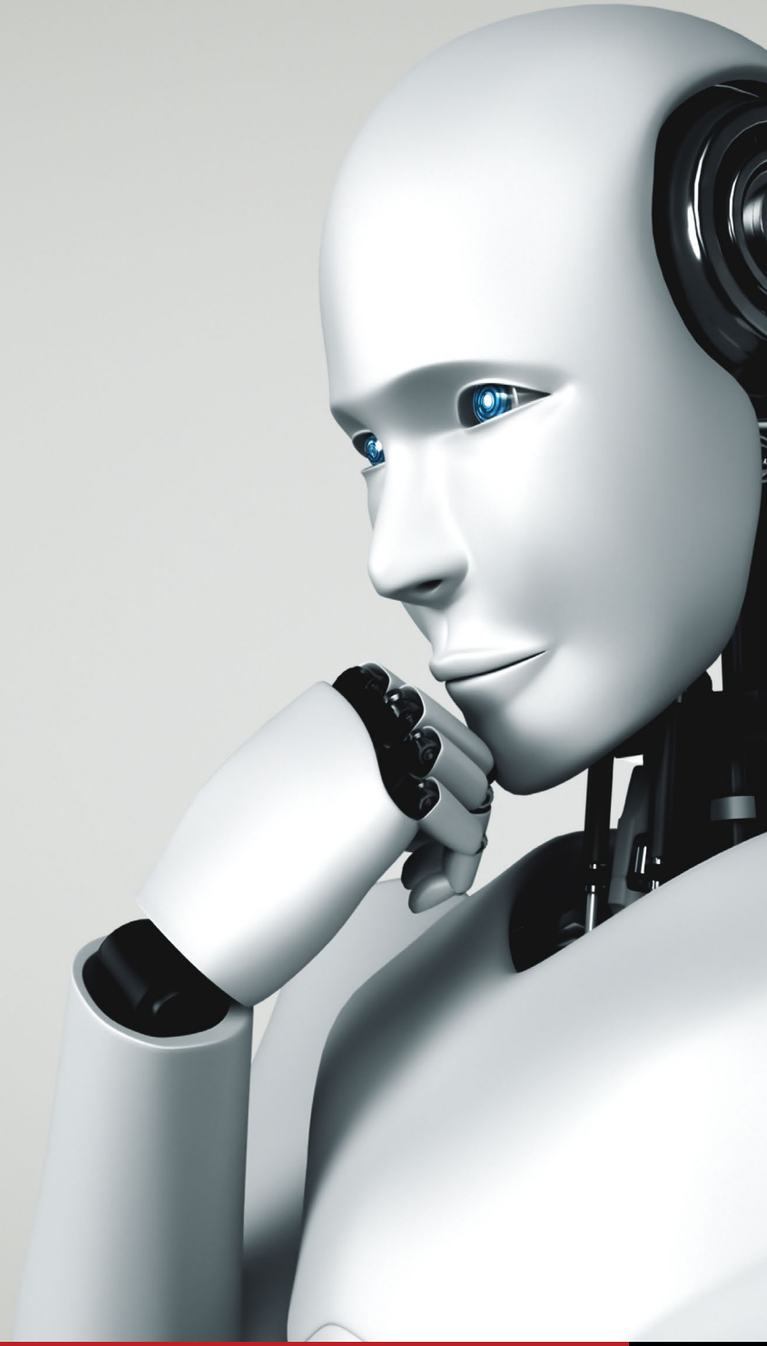
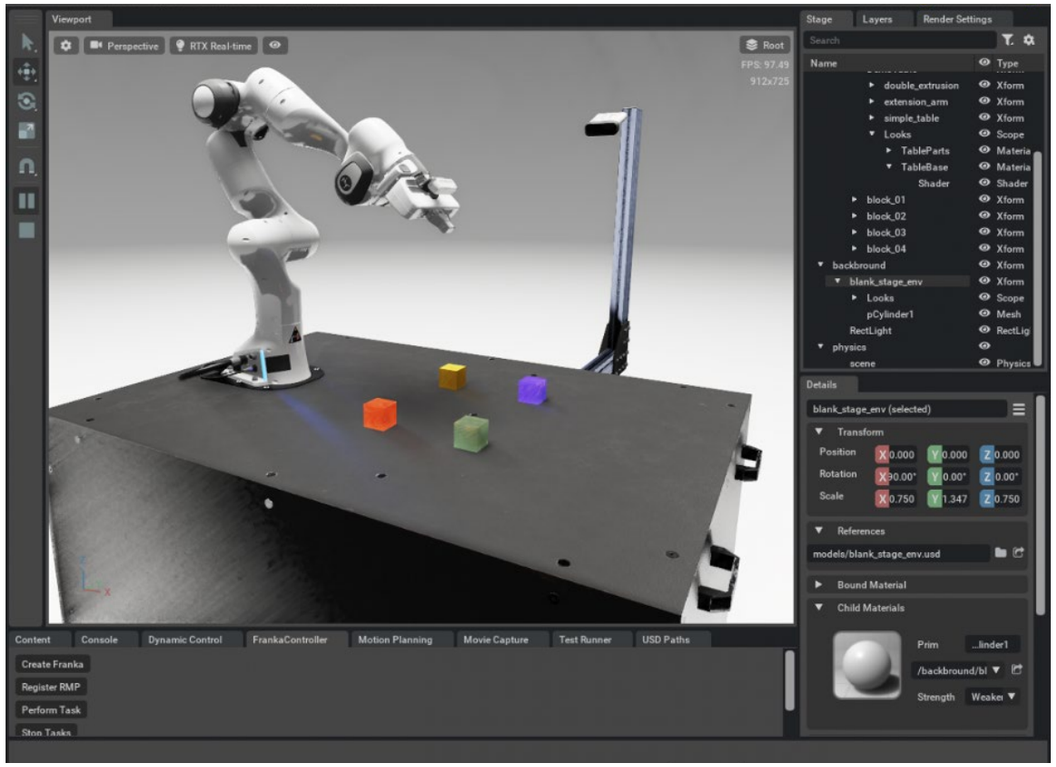


Image source: Adobe Stock/Blue Planet Studio

Nvidia has said the latest release of its Isaac Sim platform will enable more sophisticated training of robots and collaborative robots (cobots). Isaac Sim, which also includes an SDK, is a simulation program that allows for robots to be trained in virtual environments under simulated conditions. Rather than time consuming – and expensive – real-world training, engineers can train the algorithms that run their machines virtually, then port them into a physical robot to have it perform its task. Nvidia has touted Isaac, first announced in 2017, for its robustness – allowing developers to run hundreds, even thousands, of tests in a time frame that would be impossible in the physical world.

The platform has enhanced its focus on synthetic data generation – allowing engineers to create virtual scenarios that can mimic real world conditions. Pulling in real-world datasets for machine learning can be helpful, but can be limited when it comes to edge cases, situations the robot will need to respond to, but are less likely to be encountered. Reliable performance in edge cases becomes especially important in safety critical and cobot applications. If a robot encounters a situation it hasn't been trained for or doesn't expect, the results can be hazardous for humans.

Isaac Sim 2020.1 will feature a new Domain Randomization Toolbox that will allow for various aspects of a simulation, including lighting, colors,



Isaac Sim 2020.1 introduces a series of tools and features aimed at creating more sophisticated simulations for training robots. (Image source: Nvidia)

materials, and textures, to be randomized across an unlimited number of simulations without developers having to make manual changes to the simulation themselves.

It can also randomize environmental assets. In a simple example, a warehouse robot can be run through simulations where not only the lighting and other environmental conditions of the warehouse are varied, but also the placement of shelves, equipment, and other objects. When brought over into a physical robot, this will result in a much more capable and adaptable machine.

Nvidia has also introduced ray tracing into Isaac for the first time. Ray tracing is an intensive way of rendering computer graphics in a way that mimics how light moves and interacts with objects – rather than trying to imitate light by adjusting pixel values. The result is a much more photorealistic rendering than you would get with traditional methods.

If you've awed at the look of some of the SFX in recent big-budget films like *Avengers: Endgame* you've seen ray tracing in action.

By supporting ray tracing, Isaac now allows robots to be trained in simulations with much more visual accuracy to the real world. LiDAR and RGB depth cameras, which Isaac Sim 2020.1 will be able to simulate, are both affected by materials. Photorealistic renderings of environmental materials will give engineers using Isaac a better understand of how the sensors on their robots are responding to their operating environment.

Finally, Isaac Sim 2020.1 will be offering support for more robots. Carter, the virtual use case robot that appeared in earlier versions of Isaac has been replaced by a new manipulator robot dubbed, Leonardo. Those using cobots like the UR10 from Universal Robots will find a lot more fidelity between Leonardo and their own physical system. The system will also offer more robust support of ROS, allowing engineers to more easily load software stacks developed in ROS into Isaac. ■

Chris Wiltz is a former Senior Editor at Design News *covering emerging technologies including AI, VR/AR, blockchain, and robotics.*

With or Without Brushes?

maxon Watch Tutorial

Tech Disruptors: The Robot Enters the Body

Auris Health has developed a robotics system that enters the lung to diagnose a variety of issues. The sensors enter through natural openings in the body.

BY ROB SPIEGEL

Image source: Adobe Stock/Spectral-Design

The keynote panel at the Pacific Design and Manufacturing revealed a wide range of bleeding edge technology. The presentation, Tech Disruptors Transforming the Robotics Revolution, included Hari Nayar, principal technologist and supervisor of Robotic Surface Mobility Group at NASA Jet Propulsion Lab; David Noonan, director of systems and robotics at Auris Health; and Brian Schmitz, director of surgical robotics at Stryker. The moderator was Lori Jordan, former director of business development for AI and ML at Microsoft.

David Noonan explained the robotics technology that allows sensors to enter the lung to study problematic nodules.

With the Monarch Platform, Auris Health deploys flexible robotics in endoscopy. The system uses small cameras and tools to enter the body through its natural openings. (Image source: Auris Health)

Noonan noted that patient care is no longer pre-determined by the limitations of traditional tools. Auris Health creates platforms designed to enhance physician capabilities. "The goal is to use minimally invasive techniques that create new categories of care that can redefine optimal patient outcomes," said Noonan. "We provide the ability to reach parts of the lung we couldn't reach before."

Getting the sensors in the lung is one challenge. Navigating through the lung is even more of a challenge. "You need three hands to manipulate the tool. We solve this issue through robotics," said Noonan. "The ability to provide the control is the true innovation. A five-year-old can manipulate it in our test system."

Once the robotics system's sensors enter the lung, operators can use them for diagnosis. Auris Health, however, sees possibilities beyond observation. "Our patients come in with a suspicious nodule in the lung, and the robot goes through the lung to find it. We're looking to find the structure of the air paths. It gives us an estimate of where the issue is," said Noonan. "Yet,

we want this technology to go beyond diagnosis. We want it to treat patients. We'll be there in three to five years."

Can the Robot Run the Operation?

To push the technology further, Auris Health has developed autonomous navigation for the automated system. "On the robotics side, we have the technology for self-driving, but we don't have applications for it yet," said Noonan. "The doctors are not yet willing to let the robot do it by itself."

The approval process for putting technology into the human body is rigorous. Medical technology companies obtain their certifications process-by-process. "There are a number of obstacles to getting a robot in a surgical theatre. You have to define what the system needs to do," said Noonan. "You can build a prototype that does cool stuff but taking what works once into a production system is difficult. You have to track everything that is going on in the background in order to make sure this is safe. The approval for the hardware is a long process."

Connecting the Actual to the Virtual

When working with robotics in the lung, Auris Health uses of blend of vision in the real lung with a digital twin of the lung. "We use the camera view and segment it with the virtual segmentation of the lung. When we get the camera view, we search the entire virtual lung," said Noonan. "To get a computation, we do it in the real lung and that's super hard. We do it on every single frame. If you can do that in real time, you can see it accurately."

Tracking the lung in real-time while working with a virtual lung requires connectivity that is vulnerable to hacking. "Cybersecurity is something you have to consider," said Noonan. "We have dedicated security staff who worry about it for us. Being connected is important. It's the key to the rapid evolution of the product." ■

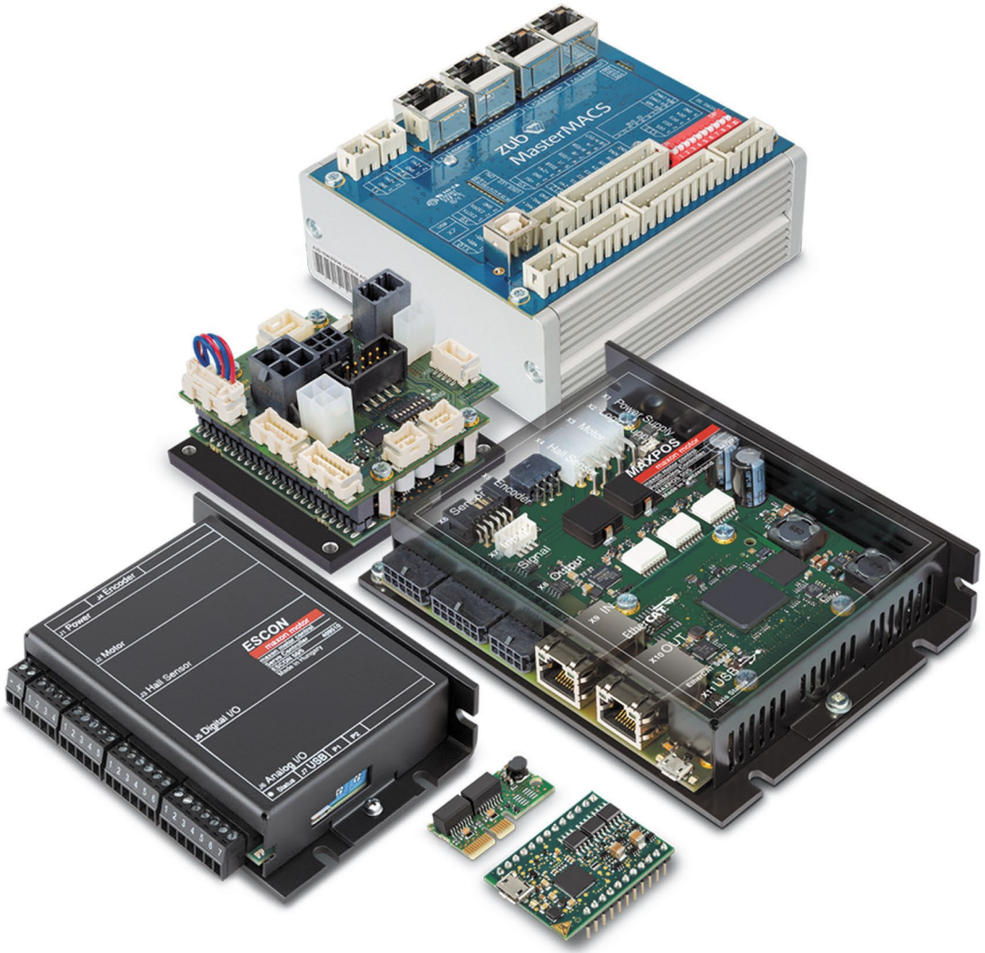
Rob Spiegel has covered automation and control for 19 years, 17 of them for Design News. *Other topics he has covered include supply chain technology, alternative energy, and cyber security. For 10 years, he was owner and publisher of the food magazine* Chile Pepper.

Get Driven
maxon magazine

Experience maxon drive technology up close. Read exciting application stories, expert interviews and much more.

Free Copy
Order Today!

maxon



Power under control
drive systems from one single source

At maxon, we develop and build high precision electric drive systems that are among the best in the world. We combine brushed and brushless DC motors, gearheads, sensors, and controllers into complete mechatronic drive systems.

When good control properties and fast startups are needed, maxon's servo controllers are the ideal choice.

For more go to: **www.maxongroup.us**

maxon precision motors, inc.
125 Dever Drive, Taunton, MA 02780
Telephone: 508 677 0520
email: info.us@maxongroup.com

Precision Drive Systems

maxon

Differences between AGV and AMR

Until recently, AGVs were the only option for automating internal transport tasks. Today, more sophisticated technology is competing with them: Autonomous Mobile Robots (AMR). Although both AGVs and AMRs allow materials to be moved from point A to point B, the comparison ends there.

Image source: Adobe Stock/Chesky

AGVs For simple programming instructions

Introduced in the 1950s, in the automotive industry, AGVs are designed to transport or tow materials. They have a major presence in logistics and allow goods to be moved within a given space without human intervention. To achieve this, AGVs can use two types of technology.

1. Wire guidance

Buried wave-emitting wires, metal rails on the ground, underground electric wires…an AGV moves by following a path plotted on the ground. The robot detects the signal transmitted by the path and follows it as if it were on a railway track. Implementing this movement technology, and modifying the path in any way, requires work. Wire guidance is therefore suitable for simple applications but does not offer any flexibility.

2. Opti-guidance

Opti-guidance is a less expensive, simpler alternative to wire guidance and allows the AGV to use onboard cameras to follow a painted line on the ground. This solution also falls short of total flexibility, but it does not require structural work.

With minimal onboard intelligence, the AGV, in its most basic version, can only obey basic programming instructions. With wire guidance, its movements are limited to fixed routes, and the slightest modification of these routes would involve substantial work and interruption of production. The AGV can detect obstacles in its path but cannot bypass them. If its path is obstructed, it will stop until the obstacle is removed.

AMRs: More autonomous, more flexible robots

AMRs are an alternative to fixed infrastructure with high start-up costs and the relatively inflexible use of AGVs. They also rely on two more sophisticated technologies.

Image source: maxon

1. Laser guidance

This system allows the AMR to move thanks to a network of reflectors integrated into its environment. The robot is equipped with a rotating laser, moves using the principle of odometry, and uses the reflectors to define its path. The combination of these two technologies allows AMRs to orient themselves with precision. In addition, it is easy to modify the robot's path using the supervision software included in the system. Laser guidance is currently one of the most reliable technologies on the market for

automated guided vehicles. Its precision makes it the favored technology for medical applications.

2. Geo-guidance

This system requires a map of facilities to be created and does not call for infrastructure development or work. The AMR can find its way around autonomously and calculate its path automatically. The advantage is that the mapping of the robot's operating environment can be modified at any time. It is, therefore, a highly flexible technology.

AMRs are a result of the latest innovations and have used the best of existing technologies. These autonomous robots have dynamic digital maps and onboard cameras and use laser guidance. They also rely on data from cameras, built-in sensors, and laser scanners as well as sophisticated software to detect their environment and choose the most efficient path to their target. AMRs can be quickly configured and easily reprogrammed, as it simply requires a change of their path on the digital map for them to act accordingly.

AGV vs. AMR: pros and cons

1. Cohabitation with people

Given that AGVs stop at the slightest detected obstacle, they are more effective in unobstructed, human-free environments. However, they are safe for humans, since they will stop if there is a risk of collision. On the other hand, AMRs have been designed to operate in more fluid spaces, where operators can safely move alongside them. Thanks to functions enabling them to analyze their environment, AMRs can detect whether they have enough space to bypass the obstacle. These autonomous mobile robots can therefore use the same path as pedestrians without any risk.

2. What's the cost?

The implementation of an AGV with wire guidance is a significant financial investment due to the required installation work. That said, the cost of designing the robot is limited by the fact that it has only minimal onboard intelligence. The AMR and its more advanced technologies constitute a greater spending item. However, the buyer will not have to perform any work to ensure that it functions properly. Given that AMRs can be deployed quickly and easily, they provide a faster return on investment.

More sophisticated than AGVs, AMRs have the advantage of not being limited to fixed routes, adapting to obstacles, and being more flexible. ■

Powerful eShop

In the maxon eShop, you can find and configure DC brushed and brushless motors, gearheads, encoders and motor controllers.

maxon

Image source: Adobe Stock/ipopba

It Takes a Village to Automate a Plant

Honeywell is delivering turnkey solutions to its customers that include a range of robotics, vision systems, machine learning, voice technologies, and augmented reality.

BY ROB SPIEGEL

Rather than selling equipment to its plant and warehouse customers, Honeywell Intelligrated is creating solutions that include a range of technologies. As the name Intelligrated implies, Honeywell is acting like an integrator, by providing a range of equipment and software to solve warehouse, plant, and packaging solutions from concept to operation.

"We're expanding our smart robotic offerings to provide end-to-end solutions to make work cells more efficient," Joseph Lui, VP and general manager of robotics, computer vision and AI at Honeywell Intelligrated, told *Design News*. "We can be a single source for autonomation for our customers. That's automation with a human touch."

Lui noted that the use of technology – including voice-guided solutions for workers to increase picking efficiencies and automated mobile robots for transporting items quickly – is just the start of the digital transformation of warehouse and manufacturing operations. "The next 10 years will see a revolution in how these centers work and operate," said Lui.


A palletizing robot from Honeywell Intelligrated on the show floor of PackExpo 2019. (Image source: Design News / Honeywell Intelligrated)

Partnering to Build a Collection of Technologies

To accomplish this, Honeywell has brought together the expertise from a range of companies and equipment providers, including software vendors, universities, startups, and incubators. "In the digital technology space, we're connecting warehouse operations to increase efficiencies by employing advanced solutions that include machine vision, smart robotics, augmented reality, and voice technologies," said Lui.

As part of the buildout for creating solutions, Honeywell has partnered with Fetch Robotics to provide autonomous mobile robots for effectively fulfilling orders. The robots operate safely alongside human workers to transport items through distribution centers without human

guidance or fixed paths. Honeywell is also utilizing a number of other robot companies. "In additional to Fetch, Honeywell has created strategic partnerships and investments in Soft Robotics and Attabotics," said Lui.

In order to blend these technologies into solutions, Honeywell has created space where all the technologies can be integrated. "We've taken these investments, and established a robotics center of excellence," said Lui.

Curating a Collection of Technologies

The investments to build out Honeywell's logistics and packaging solutions reach beyond robotics and into advances that are still in world of academics and start-ups. "We're investing in partnerships with software vendors, universities, startups, and incubators to create new solutions for both simple and complex needs," said Lui.

In order to reach some of the bleeding edge technology, Honeywell has engaged Carnegie Mellon University. "Our collaboration with AI researchers at Carnegie Mellon University's National Robotics Engineering Center is helping to develop breakthrough technologies for distribution centers," said Lui. "The focus is on building architecture relying on artificial intelligence and advanced robotic systems for advanced supply chain demands."

To support the packaged solutions, Honeywell has created platform that enables the technology elements. "Part of the collaboration comes from the Honeywell Universal Robotics Controller (HURC). This is a high-performance platform for vision, planning, and motion," said Lui. "The HURC leverages the machine learning and robotic control software to provide the processing power to handle volumes of real-time data for faster perception and more effective action. The HURC uses a virtual environment for simulation, testing, and troubleshooting to drive rapid solution deployment." ■

Rob Spiegel has covered automation and control for 19 years, 17 of them for Design News. *Other topics he has covered include supply chain technology, alternative energy, and cyber security. For 10 years, he was owner and publisher of the food magazine* Chile Pepper.

eShop Power

In the maxon online shop, you can configure your custom drive system quickly and easily. **Shop Now.**

maxon

Robot Democratization:
A Machine for Every Manufacturer

Robots are cheaper and easier to use. They're within reach for small manufacturers. Add to that a tight job market, and robot deployments are moving down the manufacturing chain.

BY ROB SPIEGEL

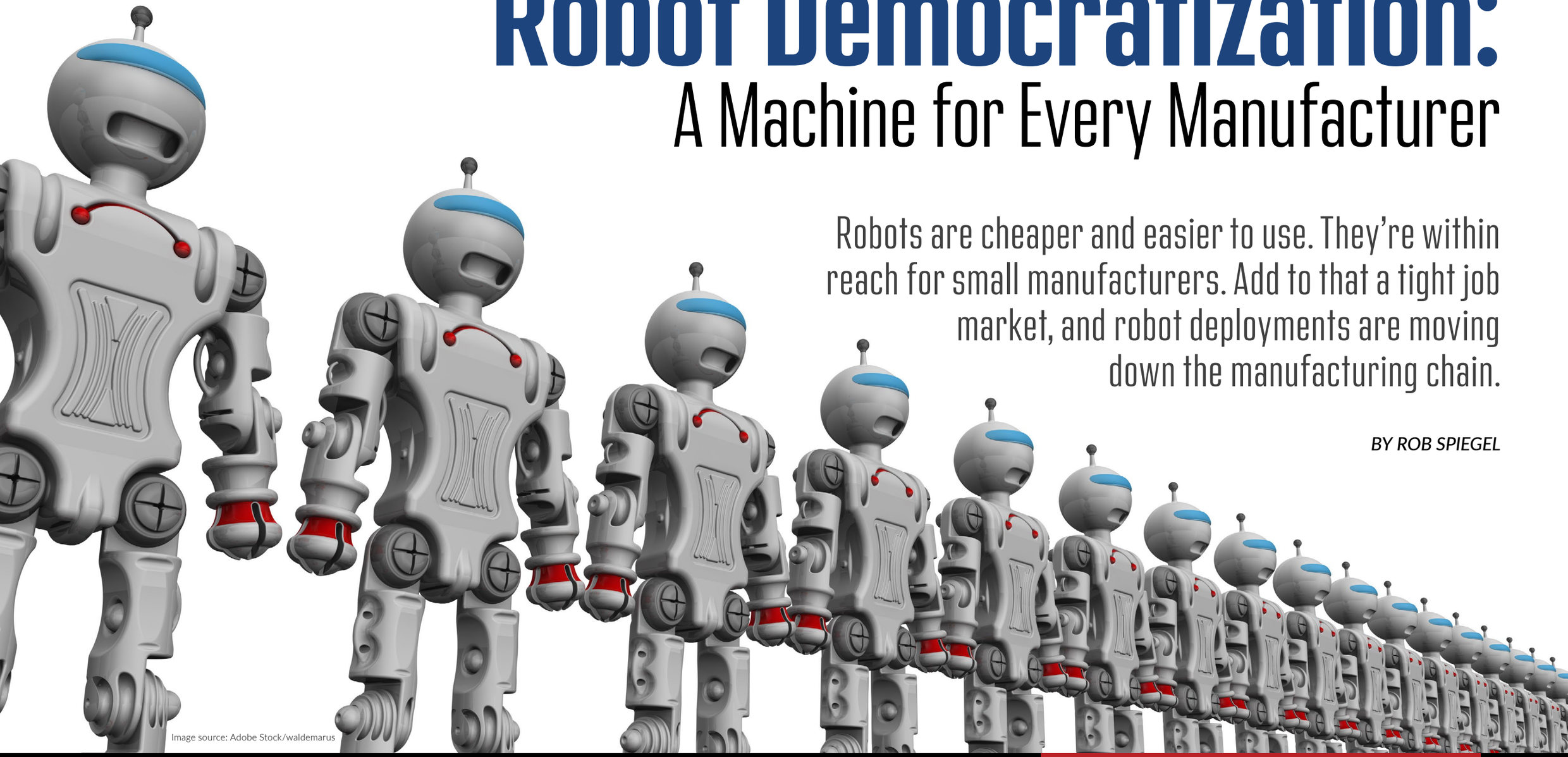


Image source: Adobe Stock/waldemarus

With collaborative robots proliferating, we wanted to know who's using these robots and what tasks they're doing. *Design News* caught up with Walter Vahey, executive vice-president at Teradyne, a company that helps manufacturers gear up their automation. Vahey sees a real change in the companies that are deploying robotics. For years robots were tools only for the largest manufacturers. They required expensive care and feeding in the form of integrators and programming. Now, collaborative robots require configuration rather than programming, and they can be quickly switched from task to task.

Vahey talked about robot companies such as Universal Robots (UR) which produces robot arms, and MiR, a company that produces collaborative mobile robots. He explained how they're putting robotics in the hands of smaller manufacturers that previously could not afford advanced automation. The difference is that these robots are less expensive, they can be set up for production without programming, and they can be quickly reconfigured to change tasks.

We asked Vahey what's different about collaborative robots and what he's seeing in robot adoption among smaller manufacturers.

DESIGN NEWS: Tell us about the new robots and how they're getting deployed.

WALTER VAHEY: Companies such as Universal Robots and MiR are pioneering the robot space. They're bringing automation to a broad class of users and democratizing automation. For small companies, the task at hand is to figure out how to fulfill their orders. It's particularly challenging to manufacturers. In a tight labor market, manufacturers are facing more competition, growing demand, and higher expectations in quality.

Robots are now within the investment reach of small manufacturers. That's fueling a surge in the use of collaborative robots. (Image source: Universal Robots)

Manufacturers can plug UR or MiR robots in very quickly. Everything is easy, from the specs up front to ordering to quickly arranging and training the robot. There's no programming, and the robots have the flexibility to do a variety of applications. Every customer is dealing with labor challenges, so now they're deploying collaborative robots to fulfill

demand with high quality.

The whole paradigm has shifted now that you have a broader range of robot applications. You can easily and quickly bring in automation, plug it in,
and get product moving in hours or days rather than months. That's what's driving the growth at UR and MiR.

The Issue of Change Management

DESIGN NEWS: Is change management a hurdle? Does the robot cause workforce disruption?

WALTER VAHEY: We really haven't seen that as an issue. The overwhelming need to improve and fulfill demand at a higher quality level helps the manufacturers deploy. It outweighs other challenges. We help with the deployment, and the manufacturers are making the change easily.

We grew up as a supplier of electronic test equipment. Since 2015, we've entered the industrial automation market with a focus on the emerging collaborative robot space. We see that as a way to change the equation for manufacturers, making it faster and easier to deploy automation.

DESIGN NEWS: What about return on investment? Robotics can be a considerable investment for a small company.

WALTER VAHEY: The customers today are looking for relatively short ROI, and we're seeing it from 6 months to a year. That's a no brainer for manufacturers. They're ready to jump in.

We work hard to make deployment less of an issue. We have an application builder, and we use it to prepare for deployment. The new user may have a pick-and-place operation. They choose the gripper, and we guide them to partners who make it easy to deploy.

The application builder helps the customer pick the gripper. The whole object is to get the customer deployed rapidly so the automation doesn't sit. With MiR, the robot comes in, and we find an easy application for the mobile device. We take the robot around the plant and map it. We've work to guide customers through an application quickly and make the robot productive as soon as possible.

There are hundreds of partners that work with UR and MiR, providing grippers and end effectors. We have a system that customers can plug into. Customer can look at grippers from a wide range of companies. We're not working just on the robot

deployment. We work to get the whole system deployed so they can quickly get the ROI.

What Tasks Are the Robots Taking On?

DESIGN NEWS: Who in the plant is using the robots, and what tasks are involved?

WALTER VAHEY: There is a range of users. To be effective at training a robot and configuring it, the people best suited for it are the ones most aware of the task. To get the robot to be effective you have to know the task. By and large, the person who has been doing that task is best suited to train the robot. That person can then train other robots. Nobody's better suited to do it than the people who know what needs to be done.

The tasks are a broad set of applications. We automate virtually any task and any material movement. It's not quite that simple, but it's close. With UR, we're doing machine tending, grinding, packing, pick-and-place, repetitive tasks, welding. It's a very broad set of applications. In materials it's also very broad. Parts going from a warehouse to a work cell, and then from the work cell to another work cell, up to a 1000-kilo payload. We're moving robots into warehousing and logistics space, even large pieces of metal. The robots are well suited for long runs of pallets of materials. ■

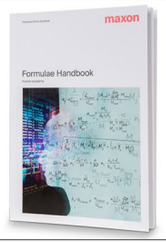
Rob Spiegel has covered automation and control for 19 years, 17 of them for Design News. *Other topics he has covered include supply chain technology, alternative energy, and cyber security. For 10 years, he was owner and publisher of the food magazine* Chile Pepper.

Formulae Handbook for Design Engineers

A comprehensive handbook, with illustrations and descriptions, formulas, terms and explanations for the calculations concerning drive systems. A valuable tool for design engineers when selecting a drive system.

maxon

Order it Today for FREE!



maxon

Precision Drive Systems

Discover More

Image source: Adobe Stock/Zoe

Intelligent Transport Systems Enhance Human–Robot Collaboration

Safe motion control and intelligent track technology are working together to enhance human–robot interaction and eliminate the need for safety cages in manufacturing.

BY AL PRESHER

The goal of human and robotics interaction in manufacturing, creating an environment where humans can safely work alongside robots, has been a long term technology megatrend that is continuing to gain traction. One recent innovation adding to this concept is adaptive machines using human-track collaboration that combines safe motion control and intelligent track technology.

Key Technology Developments

"Software, such as new safeROBOTICS functionality for delta robots, is making it easier for machine builders to embed collaborative robot arms in their designs," John Kowal, Director of Business Development for B&R Industrial Automation, told *Design News* recently. "We are also seeing collaborative adaptive machines interacting with collaborative robots to allow humans to interact with automated systems."

Kowal added that safe motion software functions allow robots and tracks to operate in safe mode when a human is in the same work

Adaptive machines are combining safe motion control, robotics and intelligent track technology into collaborative, workplace solutions. (Image source: B&R Industrial Automation)

Get Driven

Read exciting application stories and expert interviews on drive technology.

Free Copy Order Today!

maxon

area, and full performance when humans are not present. Fast processors and networks make is possible for robots and tracks to respond rapidly to safety inputs, reducing the distance required between humans and machines, which also reduces footprint. Integrating safety devices such as light curtains into the system is providing better access than traditional guarding and interlocks.

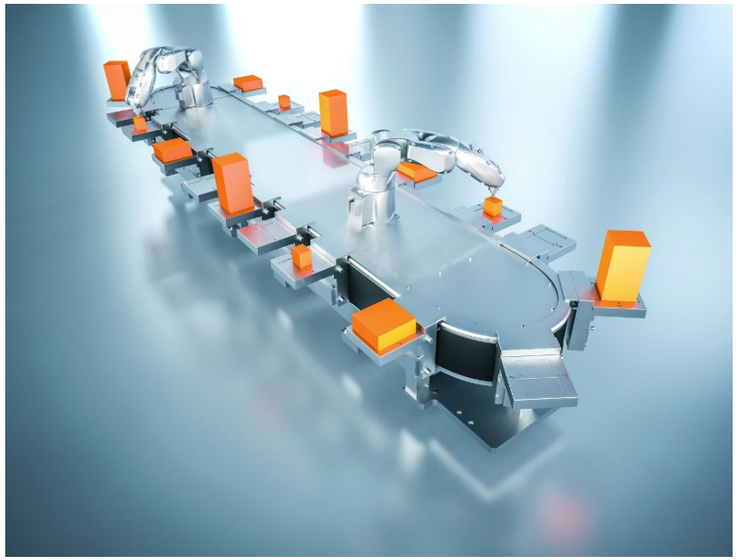
Intelligent Transport Systems

New intelligent tracking systems such as ACOPOStrak are creating options to ensure safety at manual workstations using limit values that have been defined for human-robot collaboration in technical specifications and type C standards from related fields.

ACOPOStrak features five core functions that ensure safety in human-track collaboration: Safe Torque Off (STO), Safely Limited Speed (SLS), Safely Limited Force (SLF), Safe Direction (SDI) and Safe Maximum Speed (SMS). In addition, the maximum safety response time of six milliseconds makes it possible for the shuttles to slow down to a safe speed and exert a safely limited force when in the vicinity of humans. When no one is around, the shuttles travel at full speed and full power.

SafeROBOTICS for tripods provide safety monitoring for all types of delta kinematic systems. (Image source: B&R Industrial Automation)

"Intelligent track technology enables the adaptive machine, meaning machinery that



Five core functions help ensure safety in human-track collaboration: Safe Torque Off (STO), Safely Limited Speed (SLS), Safely Limited Force (SLF), Safe Direction (SDI) and Safe Maximum Speed (SMS). (Image source: B&R Industrial Automation)

adapts to the products being produced instead of products conforming to a conventional sequential production process," Kowal stated. "One benefit is the ability, finally, to cost effectively achieve mass customization, all the way to batch size one. In general, adaptive machine technology is allowing greater automated flexibility for otherwise labor intensive applications ranging from made-to-order meal kit assembly to personalized cosmetic products to faster changeovers for short production runs and virtually any low volume, high variability product."

The safety functions of ACOPOStrak also enable implementation of a safe setup mode. In setup mode, the speed and force limits apply to the entire track. Once people have left the danger zone, restrictions are lifted.

Impact on Applications

Kowal added that more commercialized applications are coming to market, such as a Ronchi bottle handling system that can handle virtually any container shape and dimension with no pucks or other change parts:

Medical device production can also take advantage of an adaptive machine's inherent, individualized control over shuttles to achieve serialization, as seen in this IMA system. ■

Al Presher is a veteran contributing writer for Design News, *covering automation and control, motion control, power transmission, robotics, and fluid power.*

Get Driven
maxon magazine

Digitization and automation will completely change the way we develop and produce products. This issue of driven looks inside the factory of the future.

Free Copy
Order Today!

maxon