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Designing Like it's 2025

Next-Gen CAD Technologies Give Designers "Awesome Superpowers"

At Issue

Lee Goldberg, Editor

Fulfilling a Promise

My daughter Anwyn turned 21 earlier this month, just about the same day National Academy of Sciences published a report with some disturbing news about the state of the environment[1]. It is only one of several recent events that caused me to recall a promise I made to her a long time ago, and to wonder if I've done all I can do to keep it.

Around the time my daughter was born, I started working on a book titled "Green Electronics, Green Bottom Line[2]." When it was published in 1999, I was told that it was the first book about designing and manufacturing electronic products for minimal environmental impact, and how they could contribute to creating a sustainable economy. The book is dedicated to Anwyn, as part of a promise I made to do what I could to *"help her grandchildren inherit a cleaner, more interesting, hopeful and funnier world that's filled with more opportunities than when I got here."*

Today, there is much reason to hope that the world is helping me keep my promise. Between the last decade's worth of innovations in renewable energy, sustainable manufacturing, bioengineering, and other technologies, I estimate we have between 70% and 80% of the tools we need to create a vibrant economy that would actually improve the health of our biosphere over time. Adopting these technologies and practices would not only buy us the time we need to develop the last pieces in the sustainability puzzle, it could also serve as the catalyst for a period of extraordinary economic growth. Some of the places where engineers and product designers have opportunities to participate in building a better future include:

• Rebuilding the national energy infrastructure around a smart mix of renewable and nuclear power would greatly reduce our planet-killing carbon emissions and put an end to most of the mining, drilling, and fracking operations that have laid waste to so much of our land and water. The steadily declining cost of solar, wind, and other renewables will help provide a steady foundation for economic growth, instead of suffering from the periodic whiplash caused by wild, unpredictable fluctuations in fossil fuel prices.

• Low waste, low-emission manufacturing is possible, and economically viable for many industries. In fact, many of the leading Japanese manufacturers of televisions, solar panels and other electronics are already producing them in certified "zero-emission" factories. As we rebuild America's manufacturing infrastructure, we can learn from those experiences that show reducing or eliminating waste, and the attendant disposal costs, can actually be more profitable.

• We can design products that are cleaner to manufacture, use fewer resources during their service and, where possible, can be easily recycled at the end of their service life. Designing for the environment can also help products meet the eco-certification criteria required for sales in Europe, China, and many other markets.

• Robotics, hydroponics, data-driven organic farming and other Smart Agriculture technologies have the potential to enable farmers to produce better food with less water, fuel, and chemicals. Companies like Garmin have already cashed in on creating tools for so-called "precision agriculture" but many other opportunities remain for bold entrepreneurs to make large- and small-scale food production more sustainable.

We must embrace these opportunities now because it looks like we are almost out of time to make the transition to a sustainable economy.

For example, the report from the National Academy of Sciences I mentioned earlier documents the alarming decline in the world's animal population, which it characterizes as an "ongoing sixth mass extinction[3]", and its consequences to the fragile biosphere we depend on for life. Among the most significant effects of the die-offs (largely caused by human destruction of animal habitats) are the loss of most of the insects we count on to pollinate our food crops and a collapse of the microbial life that many natural processes within our biosphere depend on.

Meanwhile, nearly all scientists who are not on the payroll of the fossil fuel industry agree that the dramatic changes in weather patterns creating the recent wave of unprecedented droughts, floods, and other climactic shifts are largely due to human-generated greenhouse gasses. It's still unclear whether we have pushed the environment beyond the "tipping point" where the warming trend will accelerate uncontrollably as stored carbon in arctic tundra bogs, deep sea methane deposits and other long-frozen repositories begin to thaw.

It's tough to determine exactly how bad things are, but it's even more difficult to ignore the fact that immediate action is required if we want to spare our descendants from an unthinkable future. As technologists, each of us has the power (and the duty) to solve some of the challenges involved with creating the products, services, and technologies needed to build a sustainable economy, and a livable future for our grandchildren.

To honor my promise to Anwyn, I'll be covering some of those efforts here at PD&D. If you're working on a "grandkid-friendly" technology or product, or know someone who is, please write me at lee.goldberg@advantagemedia.com.

1 – the report can be seen at: http://m.pnas.org/content/early/2017/07/05/1704949114.full.pdf
2 - https://www.elsevier.com/books/green-electronics-green-bottom-line/goldberg/978-0-7506-9993-8
3 -The previous five extinctions were caused by natural phenomena.

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FirstLook

Wall Mounting for Plastic Enclosures

OKW Enclosure's SYNERGY enclosures can now be wall mounted using a new concealed suspension element. The adapter's housing can be either screwed into a wall or attached using adhesive foils, while a locking pin system provides removal protection. Each kit comes with an adapter, two adhesive foils, one holder, and two locking pins. All the plastic components are molded from ASA+FC-FR for added strength and UV stability.

- Compatible with the circular R120 (ø 4.72") and 140 (ø 5.51") Synergy enclosures
- 1.77" x 2.28" adapter attached to the housing with double-sided foil on a foam rubber canister
- Four shapes available (square, rectangular, circular, and oval)

Why Would I Specify?

- More discrete than Synergy's existing wall suspension element
- 36 plan sizes available, ranging from ø 3.94" and 3.94" x 3.94" to 7.87" x 3.94"
- Enclosures can be specified with or without battery compartments for 1.5V AA cells
- OKW can also supply SYNERGY fully customized ready for the installation of PCBs

www.okwenclosures.com

Custom Sapphire Optics

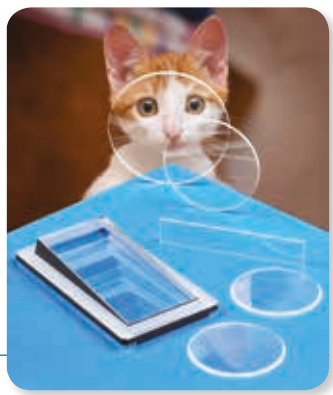
Custom fabricated sapphire optics that are clear as glass and nearly hard as diamond to provide optimum front surface protection for cameras, sensors, and other devices are available from **Meller Optics, Inc.** of Providence, RI.

- Transmission from the UV to IR (270 nm to 4.7 microns)
- Water-clear
- Mohn 9 hardness
- Manufacture red in sizes up to 10 inches in diameter

Why Would I Specify?

- Ideally suited for windows and lenses used in harsh environments, due to optimum front surface protection from fast-moving dirt, sand, water, and most chemicals
- Flatness to 1/10th wave in the visible and < 2 arc sec. in./in. parallelism with finishes from 60-40 to 40-20 scratch-dig
- Applications include cameras, weapons, refractometers, machine inspection

www.melleroptics.com



Rugged Ethernet Cable

DataMax Extreme Ethernet cable from **Quabbin** has a specially designed jacket developed to survive the many industrial hazards that commercial jackets will not. The DataMax cable jacket is pressure extruded over the cable core, "locking" the conductor pairs in place. This type of jacket construction provides very stable electrical performance, even when impacted, bent, or repeatedly flexed.

- Cables designed to be exposed to continuous flexing
- Tested for Ethernet Internet applications including EtherNet/IP systems
- Complies with TIA 568-C.2 Category 5e and TIA 1005

Why Would I Specify?

- Available in 24 AWG, 2 or 4 twisted pairs with color coded high density polyethylene insulation
- Choice of unshielded or overall braid and foil shields
- Chemical, moisture, and flame resistance, and low temperature flexibility
- Type CMX Outdoor - CM and AWM Style 2463 UL classified
- Made in the USA

www.automationdirect.com/multiconductor-cable

Direct Drive Motors

The Drives & Motion Division of **Yaskawa America, Inc.** has introduced a direct drive servo motor with a new level of performance and a more compact size than anything offered before. The new Yaskawa SGM7F line of direct drive servo motors delivers from 4 to 35 Nm of torque in a device as small as 2.1" high and 5.3" in diameter (53x135mm). This size advantage makes it possible to apply the mechanical benefits of a direct coupling between a servo motor and a load in tighter spaces than ever before. Machine designers can use SGM7F to make automated machinery more compact, freeing up valuable space on crowded plant floors.

The chief advantage of direct drive products is the ability to attach a load directly to the servo motor, allowing a full range of motion control without the need for a shaft coupling or gearhead. Other features include:

- An open core design that adapts easily to shaft mounting and allows wiring to pass through easily
- Eight different models to suit a wide range of industrial applications

Why Would I Specify?

- 24-bit encoding for exceptionally precise motion control
- A self-cooled design that generates a low level of heat
- Ideal for applications which require downsizing and shorter cycle time

www.yaskawa.com

Conveyor System Components

A full line of shaft collars, rigid couplings, and mounts for building conveyors with varying load capacities and environmental considerations are available from **Stafford Manufacturing Corp.** of Wilmington, Massachusetts.

Stafford Shaft Collars, Couplings & Mounts are ideally suited for use in virtually all conveyor systems as stops, spacers, and mounting devices for guides, rollers, sensors, and other structural and mechanical components.

- Over 4,000 standard parts available
- Custom manufacturing experience

Why Would I Specify?

- Stafford Shaft Collars, Couplings & Mounts come in 1/2 inch to 6 inch diagonal I.D. sizes
- Available in aluminum, stainless, steel, specialty alloys, and plastics

- Manufactured in one- and two-piece clamp types and in set-screw styles
- Custom work available

www.staffordmfg.com

Vector Network Analyzers

Saelig Company, Inc. has introduced the Pico Technology PicoVNA 106 Low-Cost Vector Network Analyzer - an economical USB-controlled, professional-grade 300kHz to 6GHz Vector Network Analyzer (VNA). Today's engineers don't have time to become microwave specialists. They need a straightforward, accurate, fast, portable and low-cost measurement instrument, and ideally one that can support developing applications such as 5G, IoT, radar, and tissue and materials imaging. Pico Technology's expertise in compact USB instrumentation, combined with its experience with high-performance sampling oscilloscopes and time domain reflectometry, has created a VNA that can characterize high-frequency interfaces, devices, multi-path interconnect and antennas.

- Dynamic range of up to 118dB at 10Hz
- Only 0.005dB RMS trace noise at its maximum bandwidth of 140kHz
- Gathers all four S-parameters at just 190usec per frequency point

Why Would I Specify?

- Cost-effective as a high-dynamic-range scalar network analyzer where phase measurements are not needed
- Includes bias-Ts for the convenient injection of a bias or test stimulus
- Windows-compatible software supports a full range of plot formats for a scalar or vector view of dual or single-port parameters

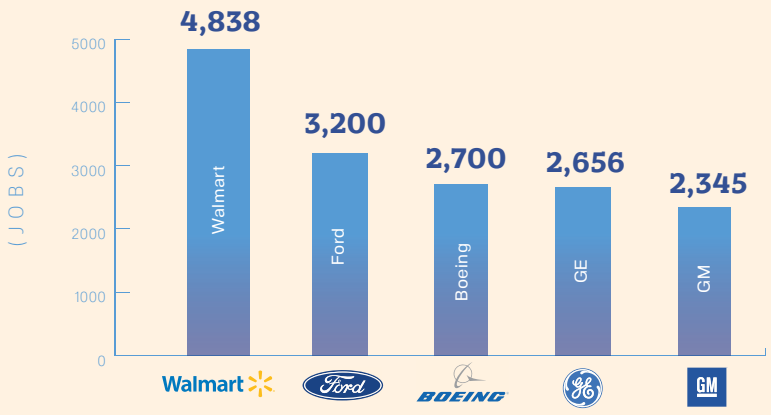
www.saelig.com

Infographic

The New American Reshoring Movement

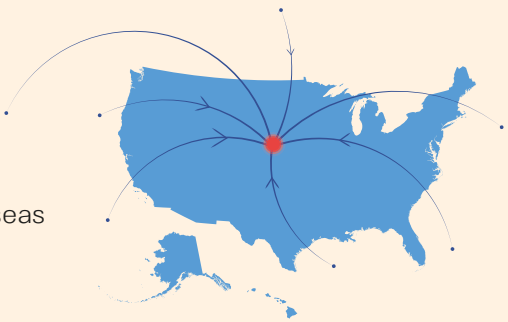
Automation's impact on jobs

The 5 Top Creators of "Reshored" Jobs



16,000
reshoring jobs

Boeing, Ford, GE, and GM claim to have brought nearly 11,000 jobs back from overseas facilities while WalMart claims that its "Buy American" program helped its U.S.-based suppliers add the remainder.

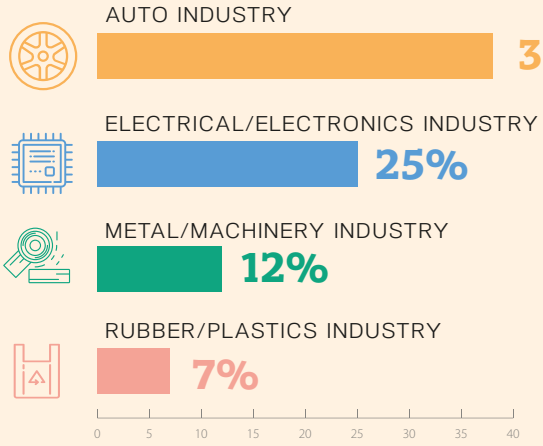


Industrial Robot Sales in 2015:

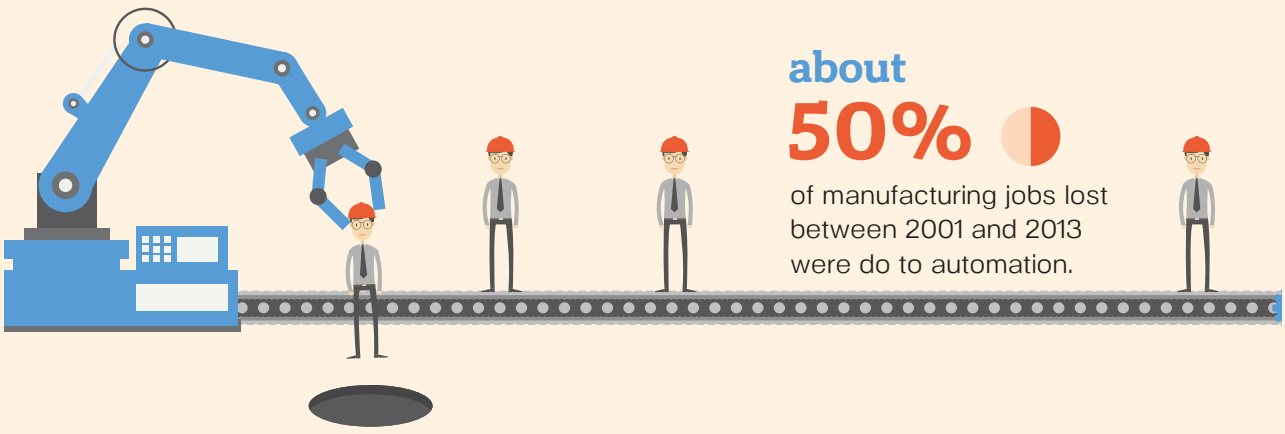
+15%
sales increased

While offshoring is a major villain these days, automation has also had a large effect on U.S. manufacturing jobs. In 2015, industrial robot sales increased by 15% to **253,748 units**, the highest level ever recorded. Value of the global market rose to **$11.1 billion**.

Who's Buying All Those Robots?



It turns out that only four industries accounted for 82% of the robots sold in 2015. It's unclear whether this is because other major industries are lagging in their move to automation or if they are already heavily automated.

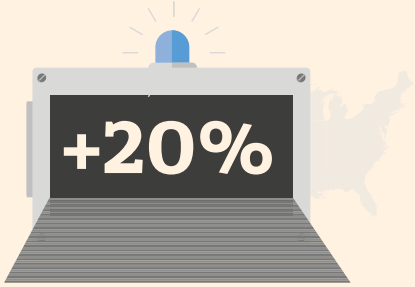


about

50%

of manufacturing jobs lost between 2001 and 2013 were do to automation.

Since the worst of the Great Recession in 2009, U.S. manufacturing output has increased more than



12.3 million

As manufacturing gets more specialized, wages have risen. Today, there are 12.3 million manufacturing workers in the U.S. earning an average salary of $81,289

$81,289

Sources:

http://bit.ly/2u2pj9p http://bit.ly/2u2Kpoa http://bit.ly/2u2hyQC
http://bit.ly/2uwtqwB http://53eig.ht/2u2oVaG http://bit.ly/2uwq8cV

Efficient Valve Control Circuits Extend Battery Life in Portable/ At-Home Medical Devices

By Samuel M. Ruback, Market Development Manager
Precision Fluidics Division, Parker Hannifin Corporation

Given the fast-rising costs of in-hospital medical treatment, healthcare providers are constantly searching for portable, user-friendly products that will help them discharge their patients sooner without compromising the quality of care provided.

A growing number of portable medical devices employ precision solenoid valves to transfer gases (such as room air, nitrogen, oxygen, hydrogen, etc.) or liquids. Applications include sieve bed switching/equalization and oxygen delivery in oxygen concentrators, cuff inflation/deflation control for the treatment of DVT (deep vein thrombosis), blood pressure monitoring, and high volume vacuum/pressure control in negative pressure wound therapy. However, pneumatic solenoid valves can consume considerable power and heat up quickly when operated continuously for extended periods, such as in medical devices that must work 24/7. One approach to solving this problem is the use of "hit and hold" control circuits.

The utility of portable or at-home medical devices often depends on how long they can continue to operate on battery power, so designers must be concerned about their designs' power consumption. Hit and hold circuits are often used to reduce power consumption and reduce the amount of heat a valve generates when actuated. These control circuits reduce energy consumption by using different voltages to actuate and hold the valve's position. The "hit" state refers to the rated voltage required to actuate the valve. The "hold" state is a substantial reduction in voltage (typically 50 percent of the rated voltage, though it will vary depending on specific application conditions) that maintains the valve in an actuated state. For example, a 12V valve can be "hit" with 12V and then dropped to 6V. This would reduce power consumption and heat dissipation in the valve by 75 percent (see Figures 1 and 2). Using the lower holding voltage reduces power consumption by up to 75 percent, which results in longer battery life and a cooler-running valve.

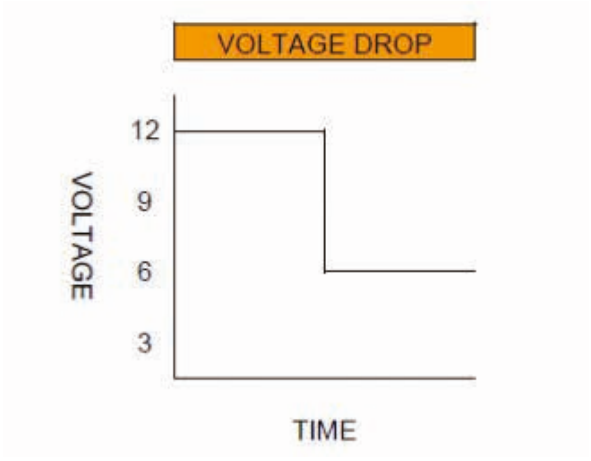


Figure 1. Voltage applied to valve.

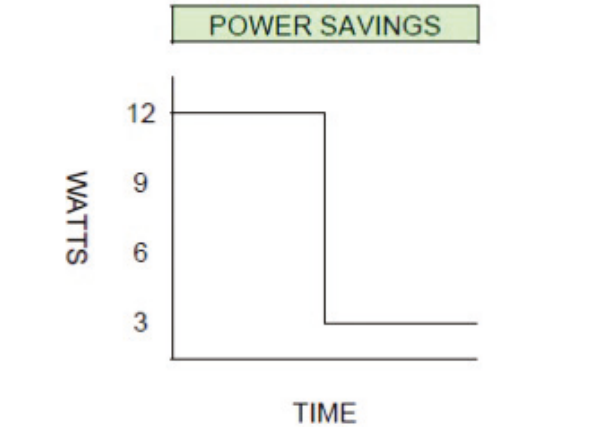


Figure 2. Power dissipation in valve

The reduced operating temperatures made possible by hit and hold circuits result in many additional benefits that can be are as important as the power savings they provide. This is because the heat generated within the solenoid coil increases its electrical resistance, thereby reducing the current flowing through it – and the magnetic force it produces. As the coil gets hotter, the reduced magnetic force in the coil may not be sufficient to actuate or hold the valve in an open position. Environmental temperatures could also affect valve performance and, in extreme conditions, can lead to malfunctions in the coil. A hit and hold circuit can reduce this risk, especially in equipment that is routinely exposed to hotter temperatures from other components within the device or the ambient environment.

PWM VS. DC VOLTAGE

Device designers can choose from two different approaches to hit and hold control: Pulse Width Modulation (PWM) (the generally preferred method) and DC voltage. Several off-the-shelf, low-side solenoid drivers sold by major electronic component suppliers incorporate PWM hit and hold control. Figure 3 illustrates hit and hold using a PWM signal to manage the power supplied to the valve. PWM reduces power to the valve by applying a square wave rather than a constant voltage roughly equal to 50 percent of the supply voltage.

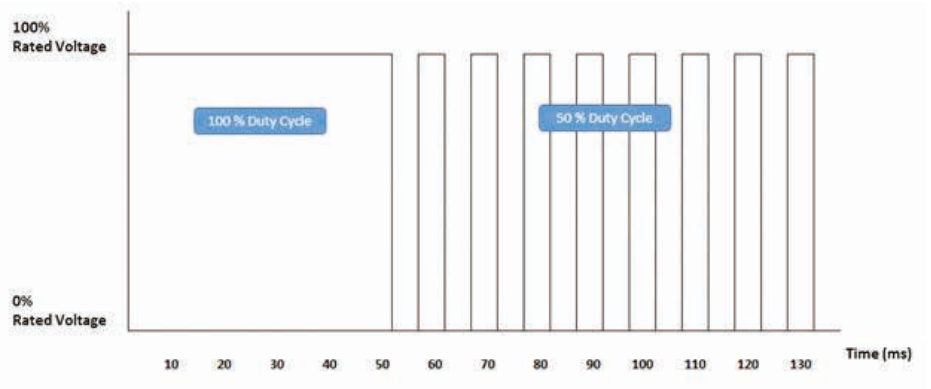


Figure 3: Hit and hold time vs. voltage

This control method greatly reduces power consumption because full power (hit) is only applied to the valve for a short period, making it ideal for applications with tight power budgets. To insure reliable operation, the valve's full rated voltage has to be applied for a minimum hit time calculated to ensure full valve actuation in all operating conditions. Once actuated, the reduced duty cycle waveform is applied to the valve to maintain its on state (hold).

Commercially available valve drivers incorporate hit and hold circuits that are useful for benchtop circuit design and development. Some sources include Allegro Microsystems, Infineon Technologies AG, Semiconductor Products Industries, Texas Instruments, and Tyco Electronics. When buying a valve driver circuit off the shelf, factors to consider include PWM frequency, duty cycle period, hit duration, and system voltage and current.

The reference circuit in Figure 4 features a low-side solenoid driver on a chip to enable PWM hit and hold control. The DRV 103 (IC) from Texas Instruments is available in 1.5A and 3A output currents and a +8V to +32V supply range. This IC can be configured to produce a PWM frequency between 500 Hz and 100 kHz. Its duty cycle can be adjusted using either a variable resistor or an analog input voltage (1.25V – 3.7V). The delay pin, when left open, has a default hit duration of 18µs; during the hit, a linear DC voltage is supplied to the valve. After this delay, the output automatically switches to a PWM output at the set duty cycle and frequency. The hit duration is adjustable from 1 microsecond to 11 seconds by changing out the delay pin capacitor.

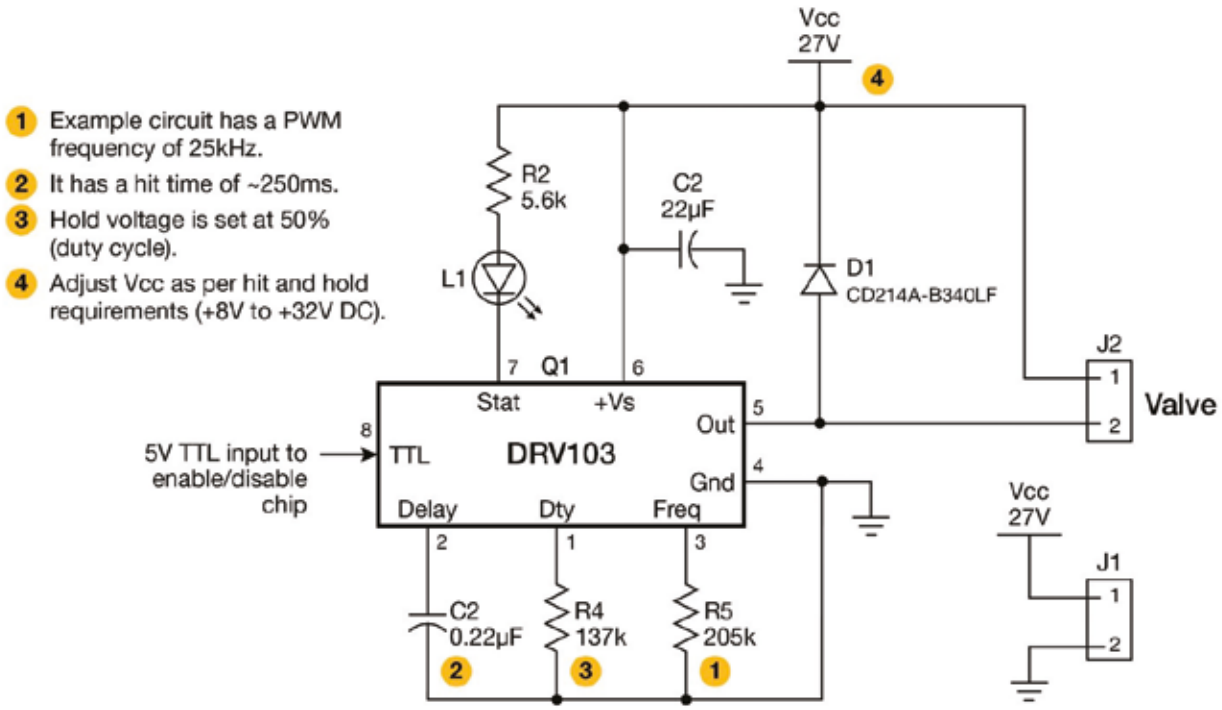


Figure 4. A basic circuit schematic.

Selecting a solenoid valve that is a good match for your application's requirements is also essential to a successful design. Some of the critical specifications you need to consider include the valve's hit voltage level, minimum hit time, hold (PWM) frequency, and hold nominal duty cycle. Compatibility with the substance to that will flow through it is also critical. Not all solenoid valves can handle both gases and liquids.

Of the valves highlighted in Table 1, only Valve D, a 9 mm miniature diaphragm isolation valve (Figure 5), is compatible with both gases and liquids.

A 50 percent duty cycle is just a general recommendation, so it's important to do some application-specific testing to determine the actual "hold" requirement for your design. Some of the factors that could affect hit and hold voltage levels include vibration, shock, pressure variation and pressure locations that are driven from specific usage. The hit and hold circuit design, combined with the valve chosen, must be validated for each specific application to ensure the valve will actuate under all usage conditions.

Figure 5. 9mm miniature diaphragm isolation valve for liquid and gas (Valve D).

Specification	Valve A	Valve B (FKM, Silicone Seal)	Valve C (EPDM Seal)	Valve D
Hit Voltage Level	**Rated Voltage**	**Rated Voltage**	**Rated Voltage**	**Rated Voltage**
Minimum Hit Time	50 ms	20 ms	50 ms	25 ms
Maximum Hit Time	20 Sec	N/A	N/A	50 ms
Hold (PWM) Frequency	5 kHz Min., 15 kHz Recommended	5 kHz Min., 15 kHz Recommended	5 kHz Min., 15 kHz Recommended	1 kHz Min., 20 kHz Recommended
Hold Nominal Duty Cycle	50%	50%	50%	50–60%

Table 1. Valve hit and hold specifications

Figure 6. 8 mm miniature pneumatic solenoid valve. (Valve B&C)

Figure 7. 10 mm solenoid-actuated poppet valve. (Valve A)

When choosing among solenoid valves for portable medical applications, you should also evaluate several other factors, such as:

- **Size**: A valve's size is critical to ensuring compact integration and the smallest possible size for the portable device as a whole. Solenoid valves as small as 8 millimeters in width are increasingly available (Figure 6).
- **Efficiency**. Look for a high flow to power consumption ratio to extend the portable device's battery life.
- **Weight**. The lower the weight of each valve, the less the whole portable device will weigh. Some popular valves weigh as little as 5 grams (Figure 7).
- **Design flexibility**. Look for universal barbed-tube or manifold mounts to simplify valve integration.
- **Compliance**. Check to make sure the valve being considered is compliant with the standards critical to the application, such as CE and RoHS.

When choosing a solenoid valve for a portable medical device, it's also important to be aware that some valves are not designed for continuous use at their rated voltage; as a result, the rated voltage should not be applied for longer than the maximum hit time. Exceeding that voltage for longer than the maximum hit time will affect valve reliability.

To learn more about how hit and hold control extends a portable medical device's battery life and reduces the level of heat generated in operation, please reach out to us at ppfinfo@parker.com.

Samuel M. Ruback is a Market Development Manager at Parker Hannifin Corporation. He focuses on solutions for the respiratory, anesthesia, patient monitoring and patient therapy markets.

NewProducts

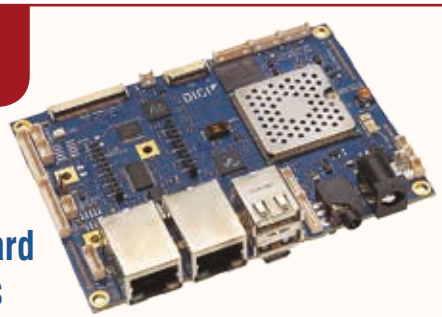
Modbus Gateways

HMS Industrial Networks (Halmstad, Sweden) now releases two new gateways connecting factory automation equipment to building automation systems – Anybus Modbus to KNX gateway and Anybus Modbus to BACnet gateway. The new gateways enable industrial devices using Modbus to communicate on building systems using KNX or BACnet. As BACnet and KNX are increasingly being used in buildings and infrastructure installations, there is an increasing demand for integrating industrial devices that communicate on Modbus into these networks. Therefore, HMS now presents Modbus-to-KNX and Modbus-to-BACnet gateways, which act as translators, allowing Modbus RTU, ASCII and TCP-devices to show up as individual KNX or BACnet-compliant devices in a building automation network.

- Increased flexibility due to ability to integrate Modbus devices in KNX or BACnet systems
- Straight-forward integration process in which Modbus RTU slaves connect to the serial port of the gateway while Modbus TCP devices connect to the Ethernet port
- KNX or BACnet gateways appear as simulated devices in the corresponding system

www.hms-networks.com/

Single-Board Computers



Digi International (Minnetonka, MN) announced the availability of the Digi ConnectCore(r) 6UL SBC Pro, a powerful, secure, pre-certified connected Single Board Computer (SBC) based on the NXP i.MX6UL (Cortex-A7 @ 528 MHz) application processor. This SBC is built to help engineers quickly bring IoT products to market and gives designers the flexibility to customize their devices with only a fraction of the traditional effort.

- A compact Pico-ITX form factor (100mm x 72mm)
- Designed to IEC 60068-2-1 standards for industrial operating temperature and rugged shock/vibration performance
- Offers integrated wired and wireless connectivity through dual 10/100 Mbit Ethernet networking, pre-certified dual-band 802.11a/b/g/n/ac networking, Bluetooth 4.2 with Bluetooth Low Energy (BLE) and optional cellular capabilities
- 4 GB of eMMC flash for data logging and storage applications
- Flexible software based and tested on the Yocto Project Linux software platform

www.digi.com/

New Products

High Performance, Low Cost, Bi-Directional Differential Pressure Sensor

MEMSIC's MDP200 bi-directional differential pressure sensor offers a wide dynamic range, long-term stability, and excellent repeatability and hysteresis for medical, automotive and industrial applications. Based upon MEMSIC's MEMS thermal accelerometer platform, the MDP200's suspended bridge microstructure can reliably detect pressure changes from a range of 0.016 Pascal to 500 Pascal.

- The MDP200 offers a superior signal to noise ratio at signal levels below 1 Pa, while offering a full scale range of 20x higher (MDP200 is calibrated at +/-500 Pa).
- The sensor chip's integrated electronics provide a 16 bit digital I2C output at an update rate of less than 7 ms.
- Typical applications include CPAP, breath detection, room pressure, damper control, flow hood, fume hood, filter monitoring and other products where ultra-low differential pressure performance is required.

www.memsic.com/flow-sensors/MDP200

Rugged Magnetic Sensor for Harsh Environments

Canfield Connector's Series CS Cylindrical Threaded Mount Magnetic Sensor provides a reliable signal source for detecting movement or actuation under a wide range of environmental conditions. Made in the USA, the rugged and compact Sensor is set within a miniature-encapsulated stainless steel M8 threaded housing that is wash-down compatible. Compliant with NEMA 6 standards and has an operating range of -20° to +80°C.

In an industrial automation setting, the sensor can detect the closure of a door and allow a machine to run. The CS Sensor can also react to magnetism that identifies changes in liquid levels or positions of parts in a wide range of vehicles, machines and systems including plastic molding machines, sprinkler controllers, security gates, meters, barcode scanners, solar panel tracking systems, smoke detectors, keyless entry devices, time clocks, telephone systems, and furnaces.

www.canfieldconnector.com

Dynamic Inclinometers Compensate for Acceleration

Posital's TILTIX family of inclinometers are now available with an optional dynamic load compensation system which guarantees precise, reliable tilt measurements for mobile machines, even if the equipment is subject to strong accelerations. These inclinometers are equipped with a 3D MEMS accelerometer and a 3D MEMS gyroscope. A smart algorithm combines the signal of accelerometer and gyroscope to eliminate the effect of accelerations (e.g. due to rapid motion of the equipment), vibrations and shocks.

With a measurement range of ±80° (Dual Axis) or 360° (Single Axis), TILTIX inclinometers provide clean measurements, even during dynamic movements, with an accuracy of 0.3°. Applications include mobile equipment such as construction machinery, mining equipment, agricultural machinery, cranes, and anywhere else where sudden movements, shocks and vibrations are likely to be encountered.

www.posital.com/en/products

Low-Cost Self-Calibrating XYZ Color Sensor

The AS7261 JENCOLOR XYZ sensor from **AMS** is a complete platform for color sensing, which eases design-in and simplifies production processes for manufacturers of professional or consumer colorimeters and color analyzers. Its features include:

- CCT and full-color sensor that provides direct XYZ color co-ordinates consistent with the CIE 1931 2° Standard Observer framework. It also maps the XYZ co-ordinates to the x, y (Y) of the two-dimensional color gamut and scales them to the CIE 1976 u'v' coordinate system.
- Multi-channel filter set integrated at the silicon wafer level, providing Dark, Clear and Near-Infrared channels as well as the XYZ color sensing channels
- Calibrated CCT, x, y, u'v' duv and direct sensor count outputs accessible via I2C or UART interfaces
- Programmable LED driver for electronic shutter control and synchronization
- Aperture with integrated lensing built into the device's 4.5mm x 4.7mm LGA package, deli-vering a ±20.5° field of view for high sensing accuracy
- A simple text-based AT command set enabling a host microcontroller or processor to configure operation of the device

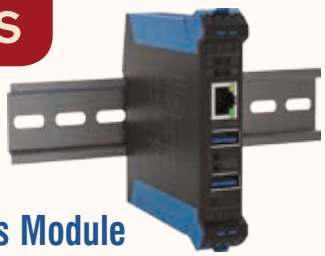
www.ams.com/Multi-Spectral-Sensing/AS7261

Displays for BeagleBone Systems

4D Systems (Sydney, Australia) has launched the gen4 CAPE series of TFT LCD display capes designed specifically for use with the BeagleBone Black single board computer. The series comprises 4.3-, 5.0- and 7.0- inch models, each equipped with a 30-pin robust FPC cable that plugs into the supplied gen4 CAPE adapter board. No additional connectors are required to operate the display since all power, control and data signals come through the FPC. Use of an adapter board, the cape that plugs directly into the BeagleBone Black, permits ease of using different display sizes to suit the application. In addition, each gen4 CAPE has the choice of either resistive or capacitive touch options.

- Resistive touch function uses an on-board Microchip AR1021 resistive touch controller that communicates directly with the BeagleBone Black over I²C in place of traditional LCD capes
- Incorporate a cover lens bezel that enables the construction of a robust yet slim design
- Focaltec CTP controller communicates over I²C
- Suits a wide range of applications

www.4dsystems.com.au/



COM Express Module

American Portwell Technology, Inc., (Fremont, CA) has announced the release of the PCOM-B700G, a COM Express 3.0 Type 7 Basic Module (125mm x 95mm), based on the Intel Xeon processor D-1500 product family (codenamed Broadwell- DE). The board is designed to be compliant with the new COM Express Type 7 standard. The module optimizes value models and service levels by running network applications securely and reliably on virtualization-optimized platforms. In addition to the PCOM-B700G, Portwell also introduces a Type 7 evaluation carrier board, PCOM-C700.

- Adds NC-SI (Network Controller Sideband Interface) as well as more PCIe lanes to meet the COM Express® Type 7 standard
- The two 10GbE-KR ports on PCOM-B700G allow customers to flexibly design their physical interface on a carrier board in several modes
- NC-SI signals provide a way of connecting BMC (baseboard management controller) on the carrier board
- Developed on a basic 125mm x 95mm size with three DDR4 SO-DIMM slots
- Optional wide operating temperature support

www.portwell.com

Engineers working within Project Holodeck's collaborative virtual design environment engage the platform's "X-Ray Vision" mode to study the internal details of the Koenigsegg Regera's drivetrain. Image courtesy of NVIDIA and Koenigsegg.

Designing Like it's 2025: Next-Gen CAD Technologies Give Designers "Awesome Superpowers"

By Alianna J. Maren, Ph.D.

The sleek sports car sits in the middle of the virtual design lab, its digital paint glistening in the ray-traced sunlight as the four digital avatars hover around it. The three design engineers, and the company's CTO who occupy the avatars, have "beamed in" to the collaborative design space from their real-world labs and offices to review a few details of the vehicle's construction. Although one of the designers speaks only Chinese, the virtual environment's simultaneous translation capabilities allow her to communicate freely with the rest of the far-flung team.

Wearing hand-tracking gloves equipped with haptic feedback elements, they interact with the detailed volumetric rendering as if it was a real vehicle.

The designers' first task is verify that recent modifications to a support bracket won't interfere with the operation of several nearby mechanisms. They peer under the car's skin using the simulation's 'x-ray vision' function and observe the bracket from several angles as the adjacent components cycle through their full range of motion.

Next, the team calls up a file containing the vehicle's assembly sequence and "fast forwards" to the point where the bracket will be integrated with the main structure. The manufacturing engineer maneuvers his avatar so he can observe the motions the manufacturing center's assembly robots will

use to move the bracket into place, looking carefully for any changes that might be required to accommodate the new part.

Although these events could easily be mistaken for a scene from a science fiction movie, advanced data visualization technologies are on the verge of making it a reality for the average design engineer.

In fact, a very similar scenario took place recently when Jensen Huang, CEO of NVIDIA, presented a live, interactive demonstration of Project Holodeck in front of nearly 7,000 people attending the company's 2017 GPU Technology Conference. The platform, scheduled for release in September of this year, incorporates the feeling of real-world presence through sight, sound, and haptics and allows creators to import high fidelity, full-resolution models into a VR environment where they can collaborate and share with colleagues.

This prototype of a swing arm for the rear suspension of a motorcycle was designed using Autodesk's Project Dreamcatcher. Photo courtesy of Autodesk Research.

During the demonstration, the audience watched the robot-like images of avatars controlled by live people interact with a detailed model of the 1500 horsepower, 240mph+, $1.9M Koenigsegg Regera supercar1 within Project Holodeck's photorealistic, collaborative virtual reality environment. Among the avatars was Swedish automaker's founder, Christian von Koenigsegg, who gave the audience a virtual tour of his brainchild, and demonstrated how the Holodeck's haptic capabilities allowed him to 'touch' the car's skin and 'grasp' the steering wheel. At one point the car was 'exploded' to reveal the thousands of component parts, each rendered in highly precise volumetric detail, requiring 50 million polygons[2].

Project Holodeck, built on an enhanced version of Epic Games' Unreal Engine 4, spearheads the growing wave of VR (virtual reality) and AR (augmented reality) methods that allow designers and engineers to collaborate in design, development, and product review. According to Dave Weinstein, Director of Pro VR at NVIDIA, "Viewing designs in true scale is important, so architects … [and] car designers can get a better sense of human factors or ergonomics issues"

As Huang explains it, "the Holodeck is not only a place [that] you go, it's a place where you can share".

NVIDIA's platform is one of several systems pushing the frontiers of VR-enabled design. Microsoft's Hololens, for example, recognizes and augments 3D imaging. Microsoft's Jason Zander, corporate VP of Microsoft Azure, says that Microsoft has been using NVIDIA GPUs for some time, and plans to use the newly-released NVIDIA Volta in its projects. "We're on our second generation of GPUs in the cloud," Zander says. "We really love Volta [because] people want to use what's available immediately, without waiting. We want data scientists and developers to focus on models and less on the plumbing".

Zander also explained that Hololens's uses the natural language translation capabilities originally developed for Skype to facilitate collaborative design and product reviews across international and linguistic borders. "With this, you can encounter someone from a different country in VR and speak to them and understand them, even though you aren't using the same language" He also affirmed that GPUs form the basis for the system's cloud-based translation capabilities, noting that "We can't do that without the power of the cloud and GPUs".

From Pixel to Voxel: A Key Enabling Technology

One key factor enabling these emerging VR capabilities is the shift from surface-based (pixel) to volumetric-based (voxel) representations of objects. Project Holodeck, for example uses a voxel-based scheme that includes object attributes that allow it to represent an automobile's internal components and surface appearance. Most other companies in the market space are using a similar approach. For example, Autodesk's new emphasis on "Deep Form" relies on representing the volumetric structure of a design. NVIDIA is supporting the trend with the introduction of GVDB Voxels, a new open-source software development kit for generic representation, computation, and rendering of voxel-based data.

Deep Form Deepens CAD Capabilities

Autodesk's "Deep Form" representation format and similar enhancements to other CAD tools have, in large part, been made possible by the shift from surface- to volume-based representation. In addition to representing the physical volumes of an object (including interior details, such as slots, machined features, and openings), volume-based modeling provides

Deep learning technology helped accelerate the ray tracing and "denoise" processes used to produce this photorealistic image. Graphic courtesy of NVIDIA.

a framework for describing the relationships between components of these objects.

Deep Forms also allow an object to be understood and managed by an artificial intelligence (AI) based "assistant," an intelligent agent within the CAD application that can work alongside a human designer, saving time by handling details and anticipating potential problems. AI assistants can also help solve design problems in new ways that an un-augmented human would find difficult or impossible.

A promising example of AI/Human partnership is Autodesk's Project Dreamcatcher that uses a combination of AI and simulation to practice what they refer to as "generative design". In this novel approach, the designer first gives a high-level description of the desired component, which may include functional requirements, material type, manufacturing method, performance criteria, and cost restrictions. Autodesk's generative design process then uses cloud-based software to "search a procedurally synthesized design space" to find and evaluate thousands of possible permutations of a solution and generate a series of design alternatives which designers can choose from and make further adjustments. This real-time interactive cycle allows the designers to rapidly identify feasible design candidates, and send them to fabrication.

Although other evolutionary design techniques have been in development for several years, most of them still employ a 'bottom-up' design process where the user specifies the design space to be searched by a genetic algorithm or similar optimizing function. In contrast, Autodesk's Dreamcatcher uses a 'top-down' approach where higher-level goals are specified. This is the major differentiator between design optimization tools and Dreamcatcher's exploratory design synthesis process.

One key factor that makes Dreamcatcher's method so effective is that it has a classified index into a very large knowledge base of pre-existing objects. This is another instance of the emerging marriage between volume-based object representation and AI, with the ability to store knowledge not only about specific objects, but about the nature of how component parts interact. Because of this, it is possible for human designers to rapidly find a viable set of candidate options in response to their initial pattern-based description.

Cloud-Based Solutions for Product Design

While only a small percentage of product design engineers will be wearing VR helmets or chatting with their AI assistants in the near future, it is very likely many more of them will be shifting to a cloud-based work environment. Major companies involved with product design, such as auto manufacturers, are leading the way with cloud-based systems supporting their in-house design efforts. "The cloud is central to everything," says CAE veteran Marc Halpern, vice president of research at Gartner. As an example, Honda's Next-gen Engineering Workstation (EWS) project is a cloud-based CAD-VDI environment for R&D offices and factories that is based on NVIDIA's Grid vGPU (virtual GPU), a graphics-accelerated cloud solution, and the NVIDIA Tesla M60 GPU accelerator. Honda has successfully deployed more than 4,000 concurrent CAD-VDI users in its initial phase, with plans to expand the new cloud-based EWS to most of its design and manufacturing operations.

Dassault Systèmes is also betting heavily on cloud technology, using it as the foundation for its 3DEXPERIENCE, an integrated "business experience platform" which includes software modules for design, engineering, modeling, and simulation activities which span the full product lifecycle management (PLM) process.

Dassault's 3DEXPERIENCE also supports many aspects of "enterprise visualization" which permits design teams to create and simulate and enterprise-level projects, including entire facilities as well as the equipment and processes that they support. Since 3DEXPERIENCE can operate seamlessly on a secure government cloud environment, the Military Contractor Rockwell Collins recently adopted it as a foundation platform in their "Co-Design to Target" solution that they use to create functional mockups and simulations of their advanced military and government projects.

A Continued Role for Surface-Based Modeling Tools

Surface-based object representations are still useful, though, in cases where the internal details of an object are not necessary. For example, the surface representations produced by 3D scanners can help reverse engineer

existing parts, compare prototypes against existing CAD models, or perform inspection on complex parts. In addition, it's often easier to hand-sculpt a model of an organically-shaped product in wax or clay and then digitize it using a 3-D scanner than to attempt to create it on a CAD system. Handheld scanners, such as Artec 3D's Leo, demonstrated at the recent NVIDIA GTC, can perform real-time 3D capture, fusion, modeling and visualization.

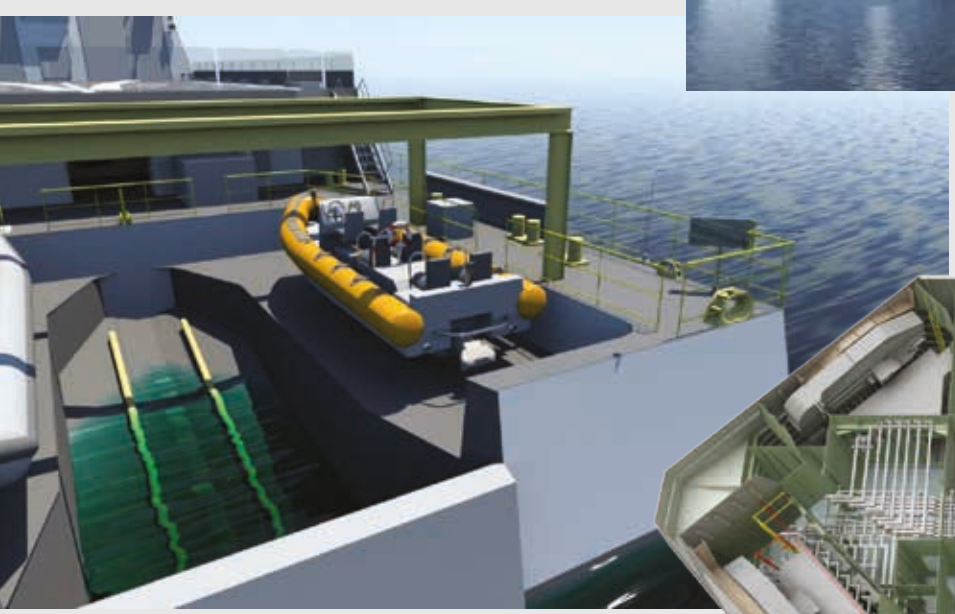
Supporting Technologies for Product Visualization

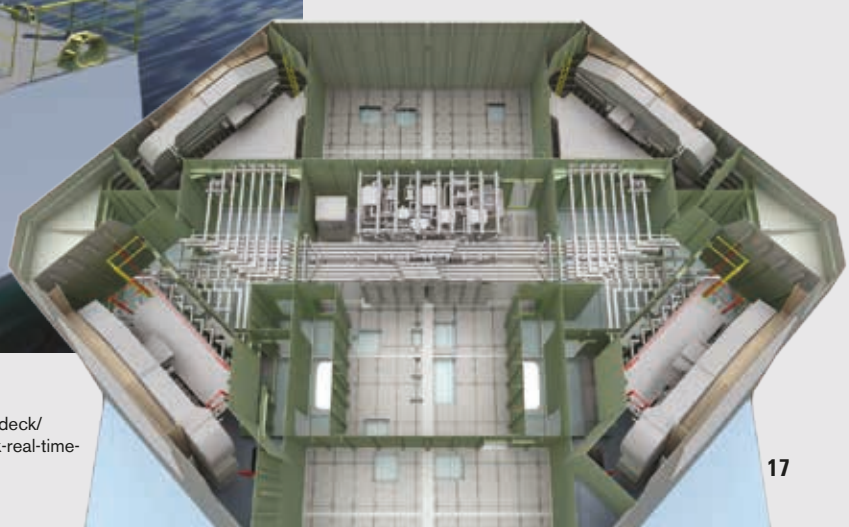
Not all companies use high-resolution visualization in their product design cycle, but it's increasing in popularity as new technologies make this very computationally intensive task fast enough to match the pace of a design team on a tight schedule. One new approach to rendering uses deep learning to accellerate the ray tracing process, using a specific kind of neural network called an autoencoder to "denoise" an image, i.e. to fill in missing details and errors the ray tracing process may introduce into a simulated scene. In a recent demonstration, NVIDIA generated two simulated images of a Mercedes SLK 350 using NVIDIA's Iray rendering technology *(See the image at the top of p16)*. Both images crisply portrayed the auto's details, as well as reflected images of trees, clouds and other objects on the surfaces of the car, but the one rendered using deep learning delivered the same level of apparent photo-realistic fidelity in a much shorter timeframe.

These, and other advanced rendering technologies are beginning to gain acceptance with companies who need their capabilities to manage development of large, complex projects. Siemens, for example, uses NVIDIA Iray and Epic Unreal Engine as part of a unified platform that generates photographic quality imagery that can be used in both AR and VR experiences. The resulting files can be used throughout the business, in design reviews, internal and external marketing, documentation, training, and sales applications. Similarly, Lockheed-Martin is using its Open GL-based COMITS (Computerized Object Manipulation In Three-dimensional Space) for both conceptual design and system readiness evaluations. COMITS is a physics-based rendering system that uses Iray along with the NVIDIA MDL (Material Definition Language), and plays a role in integrating complex radar and support systems into modern war-fighting entities, in order to verify and optimize engineering designs. It performs real-time point-cloud rendering, yielding 120 million points with sustained rendering at 60 FPS. As an example, their "virtual shipyard" uses 22 million triangles.

Summing Up

CAD tools are evolving rapidly, creating a fast-moving river in which designers can collaborate more effectively, conceptualize, prototype, and evaluate products more rapidly, and bring the product design process into greater alignment with overall digitization. This will lead to greater specific control over the manufacturing process, and designers will begin to have greater input into how the manufacturing will be done, by including how robots will build the products. Overall, the role of the designer is greatly expanding, as new tools and processes become available. PDD





Lockheed-Martin's COMITS system enables design engineers, project managers, and customers to visualize complex products and systems from the component level to an entire shipyard. Image courtesy of Lockheed-Marin and the U.S. Navy.

1 - See this demo online at https://blogs.nvidia.com/blog/2017/05/10/holodeck/
2- https://www.roadtovr.com/nvidia-koenigsegg-showcase-project-holodeck-real-time-automobile-visualization-vr/

Pitch Connectors

Following strong customer uptake of its initial release of the high-reliability Gecko Screw-Lok 1.25mm pitch connector, **Harwin** (Farlington, England) has now doubled the range, with four new pin count sizes complementing the existing product options. The company, who specializes in manufacturing interconnect solutions, has announced the addition of 20, 26, 34 and 50-contact connectors. These sizes are available in all the existing connector designs including vertical PCB throughboard and SMT in both male and female, horizontal PCB throughboard in male, cable housings in both male and female, and metal (aluminium) backshells for both male and female cable housings. Features include:

- 36 new options added to the range
- Ruggedized 'mate before lock' stainless steel screw fixing for increased security
- Inbuilt corrosion resistance against salt spray and humidity
- Single piece 4-finger beryllium copper female contacts
- Rated to 2.8A individually and 2.0A for all contacts simultaneously
- Operating temperatures spanning from -65°C to +150°C

www.harwin.com

High-Temperature Cables

Tensility (Bend, OR) introduces a cable, wire, and connector series rated to 105°C for a higher energy use and heat resistance. These products are designed for use in heavy duty applications and areas with high ambient temperatures such as outdoor settings and manufacturing. Custom insulation in the connectors allows this series to be stable at high temperatures with a similar size and footprint as other cable series. Cable assemblies are available in a variety of configurations, including plug or jack to stripped and tinned or plug to jack; right angle versions are also available. Features include:

- 105°C rating for all components in the series
- UL 2651 rated wire
- Small footprint connectors rated at high temperatures

www.tensility.com

MIL-DTL-38999 Series III Connectors Feature REACH-Compliant Surface Treatment

SOURIAU is now the world's first manufacturer of MIL-DTL-38999 Series III connectors with Black Zinc Nickel plating to comply with REACH Regulation and obtain certification from the U.S. Defense Logistics Agency. The connectors achieve REACH and QPL compliance thanks to an alternative surface treatment that delivers the same level of corrosion resistance as treatments using soon-to-be-banned hexavalent chromium.

- REACH and QPL certified, 100% chromate-free
- Available in 9 shell sizes and 54 QPL layouts commonly used in civil and military aircraft
- Includes a screw lock to ensure excellent vibration resistance
- Rated for temperatures of between –65 and +200°C

www.esterline.com/connectiontechnologies/Products/Connectors.aspx

Rugged Connectors Carry High Power + Data

Rosenberger's HPD® connector series (High-Power Super Speed Data) is a multicore connection system that combines high-speed data with high power in the same connector body. The robust, fully shielded connector system qualifies the interface for rough environmental conditions as in automotive electronics. It is complimented by a newly developed special multicore cable which has by low attenuation values and extremely low interference and crosstalk. The use of only one connector for both data and power enables installation space reduction as well as cost reduction.

The product family includes PCB connectors, straight and right angle, and complete cable assemblies. Applications for Rosenberger HPD connectors include USB 2.0 and USB 3.1-ports, display ports, high power charging, power delivery, board-to-board communication systems, for devices such as displays, smartphones, tablets or even notebooks.

- Supports data transmission up to 10 Gbps
- Supports high-power connections (up to 100 W / 5 A).
- UL 2651 rated wire

www.rosenberger.com/en/index.php

Motion Control Stepper Products

IDEC Corporation (Osaka, Japan) introduces a line of motion control stepper products in conjunction with Advanced Micro Controls Inc. (AMCI) (Terryville, CT), an established developer of motion control systems. This AMCI by IDEC product line includes controllers, stepper motors, an integrated controller/drive, an integrated drive/stepper motor, and an integrated controller/drive/stepper motor. When combined with an IDEC FC6A PLC and its embedded motion control macro instructions, these products allow users to quickly and simply implement single- and multi-axis motion control in a wide range of industries and applications. Features include:

- Macro instructions embedded in the PLC WindLDR programming software can be configured with drag and drop commands to perform control of up to 12 axes
- Integrated controller/drive/stepper motor units combine multiple components into a single unit
- Motion control macros instructions in IDEC's FC6A PLC reduce design and programming time
- No need to perform integration among the components

www.idec.com

Servo Motors

Allied Motion Technologies (Amherst, NY) introduces the HeiMotion Premium (HMP) brushless AC servo motor family. HeiMotion is available in five metric frame sizes with rated torque from 0.12 up to 14.4 Nm, and continuous shaft power from 50 W to 3.75 kW. It offers highly accurate torque ratings, energy efficiency and extraordinary durability (20,000+ hour life span). An innovative compressed winding technology allows for a compact size, as well as lower production costs compared to competitive motors. Features include:

- Standard flange sizes: 40, 60, 80, 100 and 130 mm
- Top speed ranging from 2,000 up to 9,000 rpm
- Holding torque ranging from 0.18 up to 18.5 Nm
- Winding voltage choices ranging from 48 up to 560 V
- Optimized inertia
- Extremely low cogging torque

www.alliedmotion.com

Rotary Ball Spline

NB Corporation of America (Chicago, IL) announces a rotary ball spline to ensure precise robotic movement. The NB rotary ball spline has a nut that rolls on the ball spline shaft, making it capable of both linear and rotary motion, and provides sub-millimeter accuracy every time. Features include:

- Customization to robot arm lengths using a hollow shaft ball spline
- Specify ball spline with cross rollers for greater load rating without increasing the size of the machine

www.nbcorporation.com

AVOIDING THE SEVEN DEADLY SINS OF CLUTCH & BRAKE DESIGN

CARDINAL MISTAKES INCLUDE INCORRECTLY CALCULATING TORQUE, NOT MEETING ALIGNMENT TOLERANCES.

By: Rocco Dragone, senior applications engineer, SEPAC

Medical device design puts the focus squarely on delivering improved patient outcomes. For most OEMs, that means devoting more of their engineering hours to the image-processing capabilities of an MRI than to the components that move the patient bed in and out of the magnet. Motion does play a key role in many medical devices, however. Equipment not only needs to move safely, it needs to stop, hold, and permit manual positioning with equal reliability. Those tasks require the effective application of clutches and brakes. Adding these technologies to a design can be more tricky than it seems. For engineering teams more concerned with the beam quality of their laser scalpel than how to stop it, we offer this discussion on clutch and brake pitfalls and how to avoid them.

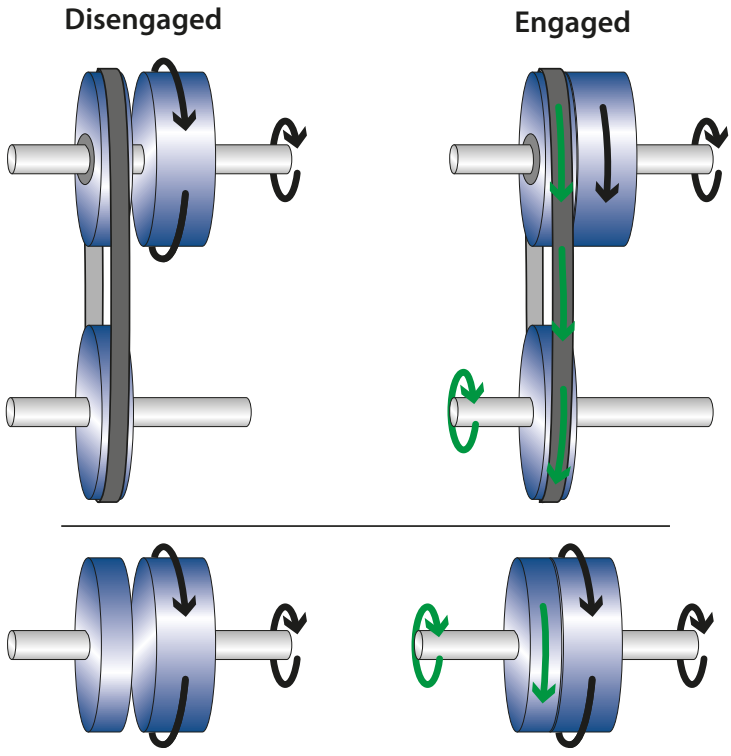


Figure 1: A clutch is used when two rotating parts must be connected or disconnected to each other, whether two shafts in parallel or two in-line split shafts. (Image credit: SEPAC)

Clutches and brakes perform very different functions. A clutch transfers torque to either an in-line or parallel shaft (see figure 1). They are used to start, couple, and/or disengage a rotating load.

A brake transfers torque from a rotating shaft to a fixed backstop, motor flange, or machine frame (see figure 2). Brakes are used to slow down, stop, or "hold" a rotating load precisely where it needs to be.

Electromechanical clutches are based on a combination of electromagnetic and mechanical principles. They consist of a field coil, a rotor, and an armature that connects to the load. Running electrical current through the field coil induces a magnetic field that crosses the air gap to induce a magnetic-field distribution in the rotor. The rotor magnetically couples to the armature, forcing the two into tight contact. The interface between rotor and armature can take multiple forms, the most common of which are friction contacts and toothed contacts.

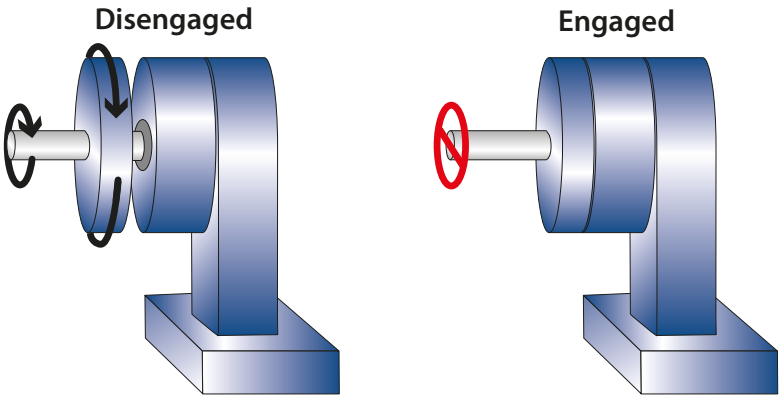


Figure 2: A brake is used when the load must be held statically, or stopped dynamically to a backstop, motor, or machine frame. (Image credit: SEPAC)

Electromechanical brakes work on a similar principle. They consist of a field coil and armature only. The field coil is attached to a fixed surface such as the motor flange machine frame, etc. Running a current through the field coil induces magnetic coupling to the armature using interfaces similar to those used in clutches.

Both perform an essential role in powered and manually controlled equipment. They improve performance with start, stop, and holding functions. They also support the stringent safety requirements of medical devices, such as enabling them to maintain position in power-off situations. By avoiding the pitfalls below, OEMs can specify a clutch or brake that supports all of the core objectives of their product, including performance, lifetime, safety, and cost.

SIN #1: USING THE WRONG EXPRESSION TO CALCULATE TORQUE

The torque required to manage the load varies depending on whether the brake/clutch is being used to start/stop the load or hold the load in place. In the case of starting or stopping, the torque needs to be calculated to overcome the effects of inertia. In a static situation, the brake/clutch assembly simply needs to hold the load in place. That means dynamic torque is typically much higher than holding torque. In an industrial application, miscalculating torque may simply lead to accelerated wear and frequent replacement. In a medical application, it could compromise the safety of patient and provider alike.

The basic expression for the dynamic torque T_D required to start or stop a load is given by

$$T_D = 0.1047\ (I\omega)/t + D \qquad [1]$$

where I is rotational load inertia (lb-in-s^2), ω is differential speed (RPM), t is time to speed (s), and *D* is drag torque reflected to the clutch (lb-in).

The basic expression for holding torque T_H is

$$T_H = (T/G_R)\ K \qquad [2]$$

where *T* is gearbox output torque (lb-in) and G_R is gear

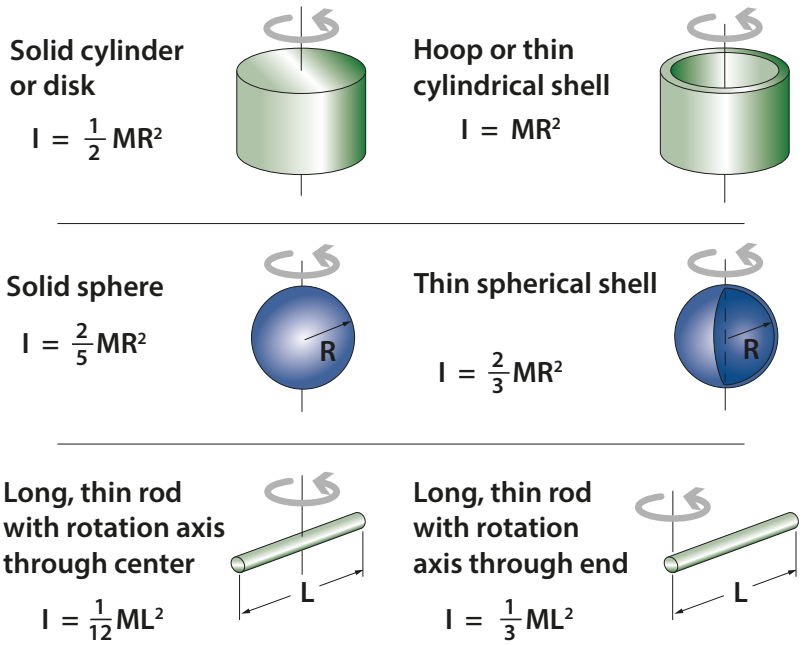


Figure 3: Free body diagrams related to rotating inertia types. (Image credit: SEPAC)

ratio. *K* is service factor, a dimensionless quantity that accounts for brake wear; the higher the factor, the lower the wear. It typically ranges from 1.5 to 3, depending on application data.

For $T = 250$, $G_R = 10$,

and $K = 1.5$, $T_H = (250/10)\ 1.5$

$= (25)\ (1.5) = 37.5$ lb-in.

Holding torque varies depending upon the mechanical configuration. Here are a few typical configurations a designer is likely to encounter:

Load driven through an actuator

Consider a load driven through a screw actuator. This is a more complex case involving a number of variables. The efficiency of the actuator, for example, varies depending on the type. Lead-screw actuators have more friction than ball-screw actuators, and so will need less holding torque. Other variables include inertia, compliance, speed, mounting configuration, and more. There is too much involved for a simple closed-form solution; consider using a commercially available sizing tool.

Load at end of lever arm

Medical devices frequently include articulated arms that incorporate brakes and clutches in the joints. This may take the form of power-off brakes designed to prevent the handpiece of a surgical robot from injuring the patient, or a holding brake that maintains the position of a dental x-ray head when the hygienist releases it. We can model these systems as a load separated from the brake by a lever arm. In this case simply calculate the torque needed to hold the weight of the arm plus the load (force x distance) then multiply by 1.5 as a factor of safety.

An unknown load

The final use case involves applications with limited information; for example, estimates made at the beginning of a project. If the motor size is known but not the load, it is still possible to estimate holding torque using the following:

$$T_H = (1.25)\ (63{,}024)\ (P\ K/\omega)\ [2]$$

where 1.25 is a factor added to account for holding the load, in addition to stopping; P is motor output power (hp); and ω is motor speed (RPM). The 63,024 is a conversion factor to give torque in lb-in. It is the product of 5,252 RPM/lb-ft multiplied by 12 in/ft.

SIN #2: FAILING TO ACCOUNT FOR A ROTATING INERTIAL LOAD

For accurate results, equation 1 needs to account for the total inertia of the system reflected back to the clutch or brake shaft. It's important to remember that inertial load varies depending upon geometry and kinetic energy. It would be different for a power door than for a centrifuge, for example, and different still for stopping a rotating load like a centrifuge versus starting a static centrifuge (see figure 3).

SIN #3: MISSING ALIGNMENT TOLERANCES

Electromechanical clutches and brakes are extremely sensitive to misalignment. That wouldn't be a problem if they could be factory assembled, but the armature and rotor/field coil arrive as separate assemblies to be installed in the equipment. For toothed clutches and brakes, the total error budget for positioning can be on the order of a few thousandths of an inch.

To perform as specified, these components need to be installed as specified. That means meeting the fixed air gap, without any shaft end play from the motor. The armature and rotor of toothed clutches, in particular, need to be attached to the mounting surface so that they are highly concentric and the teeth are perpendicular and mesh properly. This requires care in both assembly and installation.

SIN #4: NOT MATCHING THE RESPONSE TIME OF CLUTCH/BRAKE TO MOTOR

It's essential that clutch/brake has the same response

time as the motor. Seemingly small variations can introduce big problems. To get a sense of how this works, consider a 100 Hz AC induction motor with a 10 ms response time and a 10,000 RPM running speed. If it is paired with a brake that has a 50 ms response time, then for 40 ms at every start up, the motor is fighting the brake to reach 10,000 RPM. The result is accelerated wear of both brake and motor.

SIN #5: FORGETTING ABOUT BURNISHING AND RUN-IN

Friction brakes and clutches depend on the frictional force between two steel surfaces. Initially, surface micro-roughness prevents the two from fully engaging. As a result, a run-in period at low speeds is required before the unit can develop full torque. If an application requires maximum torque out of the box, the contact surfaces will need to be burnished, or run in. Burnishing requires expertise and specialized fixturing for optimum results. If the process takes place too quickly, for example, the surfaces may just glaze, preventing them from ever achieving full torque.

SIN #6: NEGLECTING TO SPECIFY THE COMPONENT LIFE REQUIREMENT

Establishing a product life requirement is an essential part of the design process. The clutch or brake needs to last as long as the overall unit. The choice will be influenced by factors like duty cycle, heat input, and other aspects of the application. It's important to note that many of the factors discussed above can lead to accelerated wear and early failure. Ensuring that your brake/clutch will meet lifetime requirements is a process, not a one time activity.

SIN #7: LEAVING CLUTCHES AND BRAKES UNTIL LAST

The best clutch or brake in the world won't help if there isn't room for it in the machine. Installation surfaces need to be properly machined to meet tolerance. Lifetime is strongly dependent on quality, and quality depends upon cost. Failing to plan from the beginning could leave an engineer trying to apply the remaining $200 of budget to a $1200 clutch, or to fit a 6-in- diameter clutch in a 3-in space. When In doubt, start early, consult often.

RELAX, IT'S NOT ROCKET SURGERY

Designing a clutch or brake into your system doesn't have to be hard. Start with a detailed summary of the requirements of your application. Pay attention to the issues above and keep your supplier informed so that they can assist you with selection and implementation. The result should be a system PDD performs to your expectations and delights your customers.

NewProducts

Multiturn Magnetic Rotary Position Encoder Kit

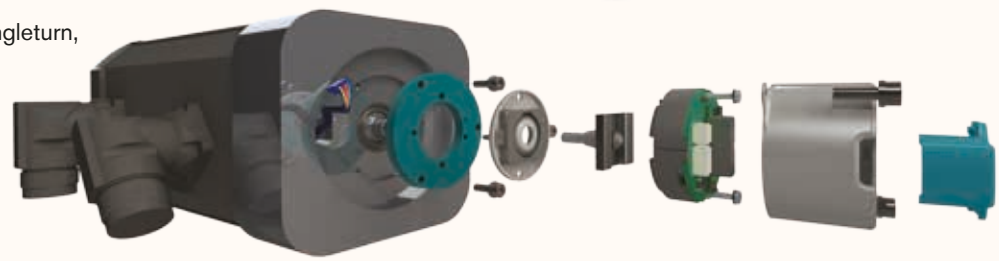
POSITAL's new family of kit encoders enable the self-contained magnetic rotary encoding technology used in the company's stand-alone rotary position sensors to be integrated within servomotors, drivetrains, and other machinery. The rugged, accurate and cost-efficient core components deliver more accuracy than optical resolvers and provide digital outputs in several industry standard formats.

The kit's electronic components, including Hall-effect sensors, a 32-bit microprocessor and the Wiegand-wire energy harvesting system, are packaged in a compact 36mm diameter, 24.2mm deep unit, making it easy to incorporate into normal manufacturing processes. The encoder's built-in self-calibration capability can compensate for small sensor-to-shaft alignment errors. An optional magnetic shield can isolate the system's magnetic pickups from external magnetic fields caused by servomotors with magnetic brakes.

Specifications:

- Electrical Resolution: 17 Bit Singleturn, Up to 32 Bit Multiturn
- Output formats: BISS C, SSI, RS485-Based Protocols
- Accuracy: 0.1˚
- Operating Temperature: -40 to +105 ˚C

www.posital.com/en



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High-Energy, High-Temperature Neodymium Magnets

Magnet Applications (Dubois, PA) Inc. announced the all-new high energy B12 compression bonded magnet. The new B12 has a typical maximum energy product, (BH) max, of approximately 12 MGOe compared to the previous generation of 10 MGOe. B12 has a maximum operating temperature of 150°C is available in nearly any geometry and size. Anticipated applications for the new magnet include motors for automobiles, transportation, aerospace, defense and other high-heat environments.

B12 Specifications

- Remanence, Br 7,200 - 7,800 Gauss
- Normal Coercivity, Hc 5,900 - 6,500 Oersted
- Max Energy Product 10.8 - 12.2 MGOe
- Max Operating Temp 150C

Magnet Applications has also expanded its Tech Center, where customers can access applications articles on topics such as What's New In Materials, How To Select The Optimal Permanent Magnet and Status of Bonded Magnets.

www.magnetapplications.com

Spring Energized Seals, Springs and Electrical Contacts

The 12-page guide, titled Sealing, Connecting, Conducting and EMI/RFI Shielding Solutions, uses photorealistic application images and descriptive insets to give readers a detailed look at where and how Bal Seal® spring-energized seals, Bal Spring® canted coil springs, and Bal Contact® electrical contacts work in aerospace and defense, analytical, automotive, energy, and medical equipment. A graph in the guide's spring technology section compares the deflection of canted coil springs with other seal energizer types, including V-springs, ribbon springs and o-rings.

The guide is available for download from Bal Seal's online technical library www.balseal.com

Requests for free printed copies: sales@balseal.com

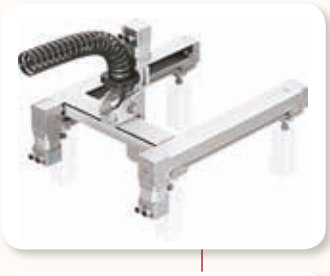
Wireless Sensor Connections

The new WIS 2 (Wireless Inductive System 2) rounds off **Pepperl+Fuchs's** (Mannheim, Germany) portfolio for the wireless connection of sensors to moving machine parts with a higher-performance system. The WIS 2 is used both for signal transmission and for supplying power to the sensors connected to the secondary side, making wear-prone trailing cables and slip rings redundant. Features include:

- Supports ratings of up to 12 W over transmission distances of 0...7 mm
- In addition to the 8-channel design, a streamlined 2-channel variant is now also available for small applications with up to two sensors
- Freely interchangeable secondary transmitters so that different tool carriers can communicate on the same system
- Space-saving Y-splitter (for 2-channel system) or 8-way connector box (for 8-channel system)

www.pepperl-fuchs.com

Low-Cost Planar Gantry Motion Systems

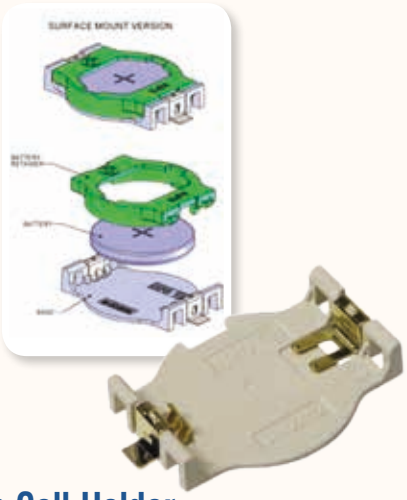


Festo (Hauppauge, NY) has introduced the unique EXCM family of planar gantries that are a lower cost, and more space efficient alternative in many applications to SCARA and Delta robots. These gantries serve as plug and play subassemblies in assembly and handling machines. XCM's gantry structure provides the optimum ratio between installation space and working space, and allows it to be installed directly on a worktable without an external control cabinet. An optional robotic controller package includes two motors and a CMXH controller that features a safe-torque-off (STO) functionality for enhanced safety. Features of EXCM planar gantries include:

- A low cost and space-efficient alternative to SCARA and Delta robots
- Precise and robust recirculating ball bearing guide absorbs large forces and torques, even at high speed
- Controller package operates with a high-power supply voltage of 24 to 48 V
- Controller's I/O interface offers PNP configuration for universal communication

www.festo.us

Rugged Coin Cell Holder



MPD's Snap Dragon series of surface-mount coin cell holders incorporate several new features which make it ideal for products which must work reliably when exposed to shock and vibration. The snap-on cover locks the coin cell is firmly in place, enabling the holder to provide a rugged and reliable connection. Shocks, vibrations, and drops do little to dislodge the cell, or even cause intermittent connections, but the cover can still be removed in a snap.

- Reliable Gold-flashed phosphor bronze battery contacts
- Snap Dragon's LCP base is fully tolerant of high temperature reflow soldering processes
- Its polypropylene cover is strong, and flexible enough to allow easy battery replacements
- Ideal for height-restricted applications – Snap Dragon typically adds only 1 mm of total height to the height of the coin cell battery above the PCB
- Available for CR2032 coin cells and several other popular sizes

www.batteryholders.com

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Manufacturing from 50,000 Feet

Karl Stephan, Professor of Electrical Engineering, Texas State University

The history of civilization is largely the history of manufacturing. Take away modern manufacturing techniques and organizations, and those few of us who would survive the resulting famines and plagues would find ourselves back in the 1700s at best. But before I read Christoph Roser's "Faster, Better, Cheaper" in the History of Manufacturing (CRC Press, 2017), my picture of how we got here manufacturing-wise was dominated by things: the steam engine, Eli Whitney's cotton gin and his interchangeable parts for guns, Henry Ford's production line—the usual high points that high-school history textbooks used to hit. But Roser shows that many of the familiar stories about manufacturing are either distorted or simply false.

Roser starts with the first stone tools that archaeologists have dated to over two million years ago, and goes from there up to today's artificial-intelligence innovations. In the process, he brings to light the fact that all the manufacturing hardware in the world won't do a bit of good unless suitable human organizations are in place to exploit that hardware in a useful and efficient way.

Roser, a professor of lean manufacturing in Germany, begins his book with a telling anecdote. The worst automaking plant in the U. S. in 1980 (a time when U. S. automakers were pretty shoddy in general) was the General Motors factory in Fremont, California. Disgruntled workers, when they showed up at all, sabotaged cars by welding half-eaten sandwiches inside doors. If enough workers didn't show up to keep the production line running, managers ran across the street and grabbed denizens of the nearest bar as substitutes. In short, labor and management relations at Fremont had degenerated to what was actually fairly typical for, say, an English shipyard of the 1600s, where workers had the right to carry off "chips" of excess wood as a fringe benefit—only a chip was defined as anything shorter than three feet long! Many of the buildings in a shipyard town turned out to be built from lumber paid for by His Majesty's navy.

Then GM entered into a cooperative agreement with Toyota, forming a joint venture called New United Motor Manufacturing, Inc. GM closed the plant, laid off all 5000 workers, and handed the keys over to Toyota. After studying the situation, Toyota managers re-hired most of the laid-off workers, and using largely the same machinery that had been so sadly misused by GM, in only a few years the Fremont plant was outperforming not only all other GM plants, but nearly every automotive plant in the U. S., putting out twice the rate of much-better-quality vehicles than before while saving $750 per car compared to the GM-only days.

What magic did Toyota work? In a word, they changed the culture of the plant. The invisible but powerful relations among employees and managers were transformed so that workers spotting problems were rewarded, not punished, and their latent human potential got a chance to develop. This real-life experiment sets the theme that Roser returns to throughout his entire history: that innovations in ways of dealing with human relationships and organizations in manufacturing enterprises have been just as important as advances in hard science, technology, and hardware.

The advent of computers has increased productivity still further since the 1980s, because information technology (IT) allows more goods to be made with fewer human workers. Roser thinks the next big advance in

manufacturing could be a scientific approach to management decisions. While IT systems present upper managers with a vast amount of useful real-time data about processes and the market, he thinks managers are no better at making strategic decisions than they were a hundred years ago. We await a science of management that will do for decision-making what interchangeable parts did for the assembly of complex machinery. But so far, Roser doesn't see that happening.

And by the way, Eli Whitney didn't invent interchangeable parts. He was a good self-promoter who staged a highly publicized 1801 demonstration before President John Adams that subsequent research has shown was, in all probability, rigged. It wasn't until after 1810 than a Connecticut clockmaker named Eli Terry found that making clock parts interchangeable would vastly increase the speed of production, and his ideas spread throughout New England.

Do you think advances in human relations and management have been more important to the progress of manufacturing than advances in the hard sciences and technology? Send responses to kdstephan@txstate.edu. PDD

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