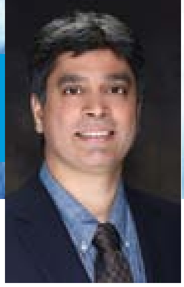

AN INSIDER'S PERSPECTIVE

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Emerging Technologies and Blast Machines

INTRODUCTION

Nicholas Negroponte, the founder of the Massachusetts Institute of Technology (MIT) Media Lab, predicted the "unwiring" of wired technology during a speech in 1984. Over two decades later, the way you use your addictive handheld devices is clear testimony to his predictions. Similarly, albeit at a slower pace, our industry has also seen its share of innovations over the years. A PLC to control the programmable features of a cleaning or peening machine is no longer an optional feature. Most machines now have a touchscreen operator interface instead of a decoration of pushbuttons and illuminating lights on the panel.

A recent news item on ThomasNet described a new design protocol at GM—they are now partnering with Autodesk. (Autodesk is a leader in 3D design, engineering and entertainment software.) GM uses the software to review hundreds of component designs, utilizing both new and legacy parts, resulting in lighter, yet stronger, components. Most of us are familiar with part/design redundancy and can relate to the advantages derived by GM with this development. Although our industry is often referred to as "low-tech and high-touch"—implying the reliance on human interaction in our processes—it most certainly has progressed along the right path. Is this path parallel to the industrial environment that's familiar with emerging technologies?

Artificial Intelligence (AI) is one of these emerging technologies. AI is the ability of a machine or any other entity to make human-like decisions given the same information. With vast amounts of available data gathered at various process points in a machine, for example, AI-enabled systems can make decisions that are structured and fact based. Our unique world of blast cleaning and shot peening is now also presented with products of additive manufacturing and related techniques, and customers are placing stringent demands of product quality, traceability and machine intelligence when their products are processed in our machines.

Robert E. Joyce, Jr, President and CEO of Norican Group (parent to Wheelabrator, Disa, Italpresse Gauss and StrikoWestofen) feels that their customers' industries are "well ahead of this curve" and cites the example of GE Aviation's investment in 3-D printing of jet turbine blades. Mr. Joyce reinforces his company's commitment to new technology when he said, "We created a Norican Digital organization last November to begin building out our strategy and approach to participate in the growing requirements our customers have in this area."

Bernhard Kerschbaum, the CEO of Rosler in Battle Creek, Michigan, a large, global manufacturer of surface finishing equipment, added, "Our equipment has already started incorporating special sensors and monitoring options including possibilities of remote access. This is Rosler's way of investing in Industry 4.0 projects and in active collaboration with our customers' process control needs."

WHAT DOES AI MEAN TO OUR INDUSTRY?

During a recent smartphone purchase, I remarked that the device cost as much as a laptop. I was consoled by the vendor with the reasoning that the phone also had as much computing power! I under-utilize the phone's capabilities by employing it only for emails, phone calls and the occasional application, but the device can't be blamed for that. Similarly, almost all well-designed blast cleaning machines and all shot peening machines are built with a PLC and process monitoring/control components. They have the potential to share a significant volume of information. We are certainly not using them to their full potential either.

Mr. Joyce agrees with this when he said, "Norican's metal-part manufacturing customers are keen to unlock the hidden potential of their operations through a much richer and deeper understanding of the information that each machine is (or could be) generating. We categorize this into Machine-based and System-based data sets. Machine-based data sets include real-time energy consumption, energy transfer, sound levels, and wear part degradation. System-based data sets use the results of the machine-based data to transmit important information through the production flow to alter downstream operations in the event of a machine/process disruption."

To illustrate this, let's take the example of a high-production environment where blast media flow from nozzles or wheels is designed to be continuous to eliminate blast stabilization delays. A classic example could be an inline connecting rod peening machine with two sets of identical blast wheel arrangements in series to peen both sides of the rod after flipping each part, or two distinct machines in series in the case of coil spring peening where the second machine is employed for dual peening. Any irregularity arising in the first machine, such as that caused by reduced media flow, will require increased exposure time, translated into reduced conveyor speed. Temporarily ignoring the need for new saturation curves, etc., in both cases, the second machine could alter its process parameters to correspondingly slow down the cycle or, in certain cases, shut down the blast wheels so that machine component wear is reduced with corresponding control of operating costs. Downstream processes such as inspection or super-finishing would also benefit from this communication. Blast machines are maintenance-intense and such data transfer allows predictability of wear and the required planning for it.

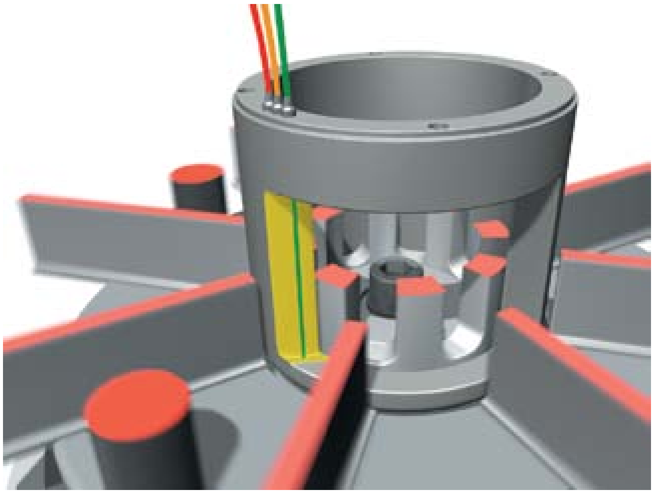
"Specially formulated controls in Rosler machines notify the user of required maintenance tasks based on machine run-times," said Bernhard Kerschbaum. "The next level of sophistication uses sensors that monitor parameters such as vibration to improve the accuracy of predicting component wear and eventual failure." Mr. Kerschbaum is drawing our attention to the limitation of AI-compatible controls when he added, "Continuous measurements of surface finish or effectiveness of shot peening results are not always practical, and self-learning systems have to rely on post-process inspections involving an offline surface measurement or a trained eye."

IS AI LIKELY TO ALTER THE INDUSTRY STRUCTURE?

Automated blast cleaning and shot peening operations have already embraced advanced technology. For example, industrial robots, used for machine tending and mainstream blast and handling operations, have increased exponentially. Robots with better sealing and build quality are used now even in dusty environments. As for controls, aerospace customers have already placed enough demands on us that we're experts in designing controls with process checks and traceability. In response, quality equipment manufacturers have supplied machines with hardware capable of generating "big data" such as pressure/speed/velocity monitoring, closed feedback loops for media flow, real-time display and correction of process parameters.

These developments have prompted the machine operator to acquire new skills. The operator is now capable of robot path programming in addition to simply calling up a recipe/technique to peen a part. Complex parts such as blisks require advanced programming techniques since they present the risk of distortion if peened unevenly. The AI architecture now adds a purpose and effective use for this generated data.

There's another advantage to the machine's decision-making abilities. Mr. Kerschbaum said, "With such monitoring and diagnostics, fewer experts can monitor more equipment. Introduction of Industry 4.0 and IoT (Internet of Things) to equipment will help compensate for the growing skill shortage in manufacturing." He makes a great point because automated process compensation and control achievable through AI have the capacity to direct the customer's team to an impending issue (control cage wear, recorded by a sensor, that has started altering the blast pattern for example), or alert the OEM's service staff to place a service call in the immediate future.



Sensors inside a Wheelabrator blast wheel identify wear and automatically shift the control cage.

In a blast machine, it's common to hear the operator comment that "the machine doesn't sound right during operation." Let's take the example of a wheelblast machine where the parts that commonly wear are within the wheel/turbine assembly. The machine/blast wheel generates a characteristic sound when operating at optimum performance and sounds distorted when not doing so. Rotating at 3000 RPM and generating media velocity about 300 feet per second, this dynamically balanced assembly can demonstrate greater maintenance predictability when its individual parts such as control cages, impellers and blades are closely monitored with regular reports of its normal wear patterns. In other words, the reliance on a human and the variance in interpretation among different operators no longer need to be the predictor of maintenance.

"The new industry shift is perhaps not so positive for suppliers that do not respond by designing their equipment to be Industry 4.0 compatible. In the future, the value of equipment will be gaged based on its ability to improve shop floor data flow in addition to its obvious task of shot peening a part to required specifications. If a blast machine supplier is unable to improve shop floor data flow, that gap might be filled by technology companies with the possibility of them emerging as major players in our industry by displacing blast machine companies," predicted Mr. Joyce. He explained it further by providing an example of UPS partnering with SAP to set-up 3D printing capabilities throughout the United States. Mr. Joyce added, "One will have to go back to the industrial revolution to look for a similar shift given the exponential amount of change unleashed in our customers' industries in the next decade."

How plausible is this in our industry? What will happen to your customer's constant demand for consignment spare parts when they can 3-D print them in their own plant? How about patents, duplication, and ultimately the liability? Additive manufacturing is gaining prominence in the manufacture of production parts and will this lead to an end-user that prints blast nozzles or blast wheel parts? These are relevant points that will get addressed as we adopt this shift into our daily schedules. Like most, our industry is also driven by the demands of our customers, predominantly automotive and aerospace. As we know, AI is not just a buzzword in both industries. Our industry will have to find a way to work through procedural hurdles and think in terms of the benefits it can provide.

IS MY JOB AT RISK?

This is probably the most commonly pondered question in our industry! Gary Kasparov was the world chess champion who had won over 180 championships when in 1997 IBM's Deep Blue beat him at his own game. In a recent TED talk, Kasparov eloquently explained that the triumph of machines is indirectly a human victory. Rather than fearing AI and the effect it might have on your career, he suggests challenging it. His conviction in a successful partnership with machines is summarized in the following three resulting value sets: (Human Intuition + Machine Calculation), (Human Strategy + Machine Tactic) and finally (Human Experience + Machine Memory). These value sets emphasize the complement that machines will offer humans and point out the attributes in both parties that are distinct and can't be duplicated.

To address the question of job security, let's first explore the impact of automation on our workforce. Automation, the precursor to AI, has met the following goals: repeatability, reduction in labor costs, quality assurance and general productivity increase. Production lines were re-invented with automation and robotics replacing manual labor either by attrition or direct elimination. As production volumes and the demand for consistent surface finish increased, our industry started automating some of those manual processes with robots, both custom and standard. Along with this development arrived process control and conformance to specifications. Machine operators sought training in the process and transformed themselves into banks of theoretical know-how coupled with practical insights.

Although a shot peening machine operator may not understand Bragg's law and X-ray diffraction, the effect of increased pressure on the measurable results of arc height and over-exposure to media are known to him. AI is an extension of this knowledge, except transmitted with purpose in a digital format directly by the machine controls. In our industry, the goal of AI thus far has been in predictive maintenance. The opportunity to extend this reach to other fields is promising. The human element can't be eliminated by AI, at least not in blast equipment. However, complacency is a threat. An AI-centric approach, whether in the front or back end of the process, requires a skill-set that's heavily reliant on process knowledge. The only way to avoid redundancy is re-training, taking advantage of the generated data and improving the process.

SOME PRACTICAL THOUGHTS

It's myopic to draw conclusions on topics as fresh and evolving as these emerging technologies. Instead, listed below are some insights into the possible outcomes in our industry.

- Creation of a robust database of tribal knowledge is essential for an AI-centric system to be successful. This database can be utilized not only for predictive maintenance, but also in the front end to seek suitable solutions to a challenging shot peening or blast cleaning application.
- Additive manufacturing is growing and traditional inventory levels of spare parts could see relief. Economies of scale needs to be re-defined.
- If technology is going to take center-stage, will existing manufacturers embrace technology, or will the likes of a Siemens or Allen-Bradley dominate the shot peening process/industry?
- The shot peening world continues to develop and evolve. However, the process is still being understood only at a fundamental level by some of its users. The correlation of arc height to intensity (saturation curves), coverage and residual compressive stress are still being digested by some. Will they concern themselves with perfecting their peening process or dive into the information gathering and disseminating trend demanded by AI?
- Power, whether used to generate compressed air or operate multiple blast wheels, is expensive. By monitoring transmitted energy, blast patterns (abrasive concentration and proper targeting on the part), and speeding up and slowing down a blast cycle to compensate for upstream issues, the user can not only get a better control of operating costs, but also shut down the process rather than produce defective parts due to upstream shifts from normal. This could be justification enough to embrace this change in most wheelblast machines.

AI mimics human cognitive functions; however, AI can do it at a higher level due to the speed and power available in computing platforms. In Gary Kasparov's words, humans have understanding, machines rely on calculations. Machines work on objectivity whereas humans have dreams and a passion to achieve them. AI and other emerging technologies are now well-rooted in our customers' industries. It is incumbent upon us to use that passion to stretch the smartness of our machines to achieve tangible goals of smart productivity.