Machine Alignment Insights from Pressure Mapping Technology

Covering Several Ways Interface Pressure Measurement Technology can Open the Communication Lines Between Man and Machine

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Table of Contents

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INTRODUCTION

What is Your Machine Not Telling You?

"Computers are incredibly fast, accurate, and stupid. Human beings are incredibly slow, inaccurate, and brilliant. Together, they are powerful beyond imagination."

Dr. Albert Einstein

Contrary to Dr. Einstein's beliefs, today's machines aren't so stupid. They are highly automated and require far less human interaction to perform their functions. As a result, design engineers are tasked with the challenge of finding new ways to make smart machines smarter.

There are several internal and external factors that can affect the interface contact and fitting of machine components during operation. Every input and output, start and stop, adjustment and readjustment, has some effect on a machine's performance over time.

As design engineers continue to develop more "human-like" features in their machines, they may be missing an opportunity to capture critical feedback on what these machines are "feeling."

Machines have a story to tell, but many may lack the ability to communicate with their operator. Investing in ways to give machines a "voice" can result in a highly-differentiated, game-changing design.

When you consider all the moving parts that are in play, run-after-run, interface pressure distribution is incredibly vital for a machine to perform its programmed functions.

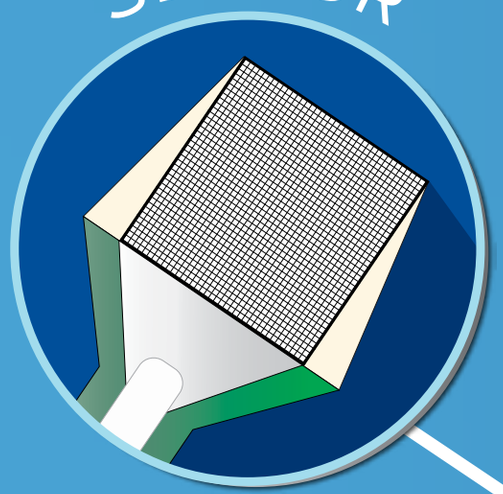
Pressure mapping technology is a diverse tool that allows R&D design engineers, field service technicians, and machine operators to capture important insights into machine performance. This ultra-thin sensing technology allows users to obtain quantitative pressure data in impossible spaces. This data can be used to establish standards for the machine's alignment, and become an embedded feature that opens the communication lines between the machine and its operator.

This eBook will cover the basics of pressure mapping technology, and its value to machine designers, operators, and in-field maintenance personnel. These examples will be supported by real-world machine alignment applications covering a wide range of production industries.

Ultra-Thin Pressure Mapping Sensors Capture Pressure Distribution During Machine Setup

COMPONENTS OF A PRESSURE MAPPING SYSTEM

SENSOR

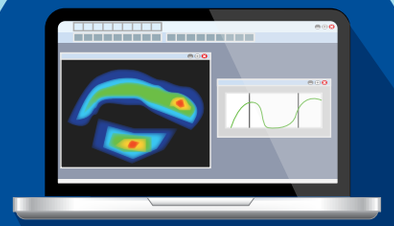


- **Minimal invasiveness**
- **High resolution**
- **Thin and flexible**

ELECTRONICS

- **Scan thousands of sensing points within each sensor**
- **Instant data relay to PC via USB or WiFi**

SOFTWARE



- **Display pressure distribution data in multiple formats for superior analysis**
- **Display pressure data graphs in 2D and 3D**
- **Capture peak pressures and center of force in real-time**
- **Allow for video playback of pressure data**

WHAT IS PRESSURE MAPPING?

Even between relatively flat surfaces, one finds the interface pressure distribution is often not uniform within localized areas of peak pressure. Pressure mapping technology helps design engineers obtain insight into areas that may impact design and quality.

Pressure mapping systems require three components – **sensors, scanning electronics, and software** – to deliver real-time, actionable data, in ways other methods cannot.

- The **sensor** transforms compressive pressure loads to a change in resistance
- The **scanning electronics** collect analog data from the sensor and convert the data into a digital signal
- The **software** displays real-time activity of the sensor area, allowing the user to see force, pressure, contact area, and timing data

CLICK HERE!
To See How Pressure Mapping Sensors are Made, and Collect Data

THERE'S A SOLUTION FOR EVERYONE

We are all driven by insights. No matter the responsibility you hold with your company or organization, pressure mapping technology is your key to obtaining interface pressure insights to solve key design, technical service, and competitive demands.

The following pages will provide real-world and conceptual applications addressing these demands.

Diverse Demands SOLVED With Pressure Mapping Technology

Design Engineer

I need a measurement tool to verify interface pressure distribution across key components and mating surfaces within my machine's design.

In-Field Service Technician

I need a data-driven maintenance instrument for my scheduled maintenance program that will provide value-added services to my customers, and ensure proper machine setup.

C-Level for a Machine Developer

I need an advanced machine design with innovative features that give my company an edge over our competitors.

MACHINE ALIGNMENT APPLICATIONS FOR R&D/DESIGN

Ensuring Repeatability of a Food Packaging Seal

The slightest defect in a food packaging seal can be detrimental, both to the production company, and to the consumer.

When designing food packaging machines, pressure mapping technology helps to capture the key insights to verify your design. This, in turn, helps to enhance the Finite Element Analysis (FEA) model.

CASE EXAMPLE: Controlling Costs of Recyclable Food Packaging

Despite their environmental benefits, the higher up-front costs for using product packaging composed of recycled or renewable materials is the most significant hurdle for many companies. Along with their varying price-points, some of these materials also come with durability or flexibility concerns.

One food packaging machine design company added pressure mapping technology into their design process. High temperature pressure mapping sensors were used to determine the evenness of the sealing components on the packaging machine, and whether this pressure distribution would fluctuate over extended use.

Because of this vital information, the machine could be optimized for packaging materials with various characteristics, including polyester, milk proteins, paperboard, and others.

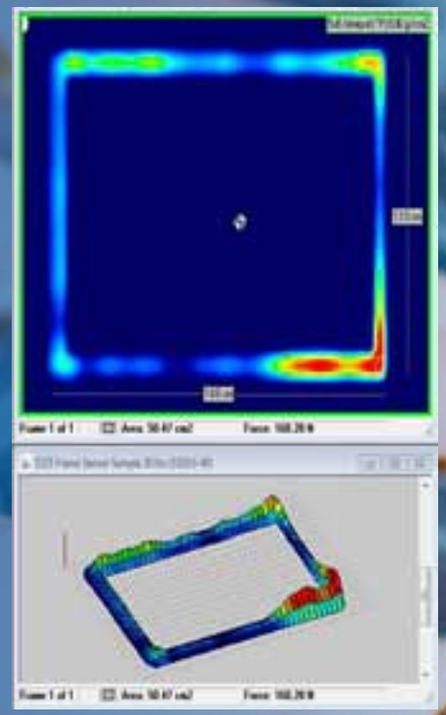


Figure 1
Example of a pressure mapping application for evaluating the seal on a Biodegradable food container

Other Similar Applications

- **Sealing Bar**
- **Fill Line Seal**
- **Medical Supply Packaging**

Refining Mold Manufacturing Processes

Pressure mapping technology can collect key insights on pressure exchanges and contacts in spaces that operators cannot reach.

In manufacturing operations, where consistency and repeatability are key, this technology can gather the critical data to help engineers determine baseline metrics for proper machine alignment.

CASE EXAMPLE: Quality Control of Composite Material Molding

Composite materials have been, and will continue to be, essential to the future of aircraft design. In general, composite materials like carbon-fiber and ceramic compounds offer benefits of being sturdy, lightweight, and resistive to high-temperature or corrosive environments. However, they often can be expensive to produce on a mass scale, which is why a sound, reliable manufacturing process is critical for ROI.

One commercial airline manufacturer, designing a carbon-fiber based airplane wing, wished to test the uniformity and repeatability of their autoclave molding machines. Their application required a sensing technology that could fit to the mold contours, without getting in the way of the molding compartments themselves.

High-temperature pressure mapping systems proved to be an effective method for the design engineers to determine pressure exchanges and contacts in real-time. The thin sensors were placed between a reinforced layer of the mold, and the composite materials, which could then record these changes and identify any potential weak spots in the process.

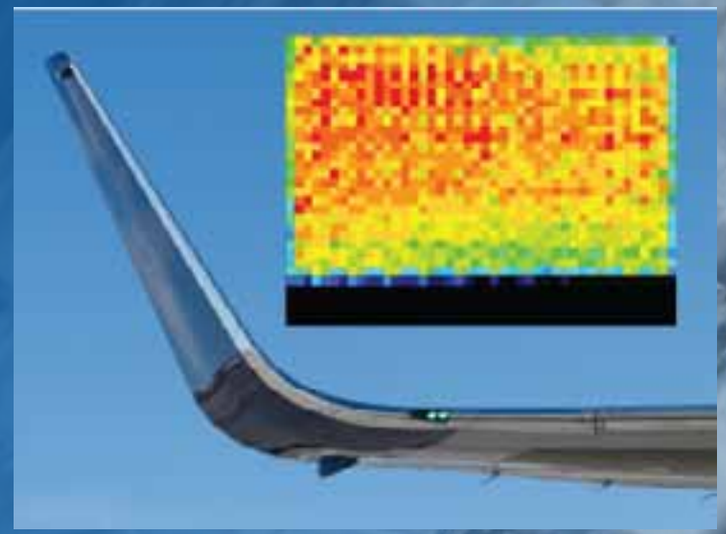


Figure 2
This image depicts an example pressure mapping reading from a composite molding application. In this test, there are clear areas of uneven pressure distribution, indicated by the red spots seen toward the upper-left portion of the testing area

Other Similar Applications

- **Injection Molding Machines**
- **Robotic Welding, and Other Assembly**
- **CNC Machine Design**
- **Door/Window Seal Quality Control**

IN-FIELD MACHINE SET-UP AND MAINTENANCE APPLICATIONS

Confirming Interface or Component Uniformity

With pressure mapping technology, field service personnel have an intuitive method to enhance the service they provide to their customers.

Some machines require a guess-and-check process to determine whether adjustments are producing the desired results. This can be time-consuming and wasteful, depending on whether multiple test runs may be required. Thanks to pressure mapping, these efforts can be streamlined with quantifiable data.

CASE EXAMPLE: Textile Production Assurance with the NPAT™ System

Textile factories employ some of the largest nip machines in the world, such as the one pictured in **Figure 3.** Proper nip contact is crucial for maintaining the uniformity of the dye being applied to the material. If operators detect improper contact, they must stop all operations, bleach the fabric, and re-run the material through the machine.

One textile machine company went to great lengths to ensure their service technicians could identify nip roll uniformity with ease and convenience. They equipped each of their technicians with a **Nip Pressure Alignment Tool (NPAT) system**. The NPAT features an array of sensing points to determine nip roll uniformity across the length of a nip roll (up to 10,000 mm (396 in.)) in real-time.

With the NPAT software, technicians can program a "gold standard" nip roll setting, which they can use to benchmark against other units of the same model machine. This digital quality control tool takes the place of nip impression paper, which can only show evidence of peak pressure, not the immediate effect of an adjustment.

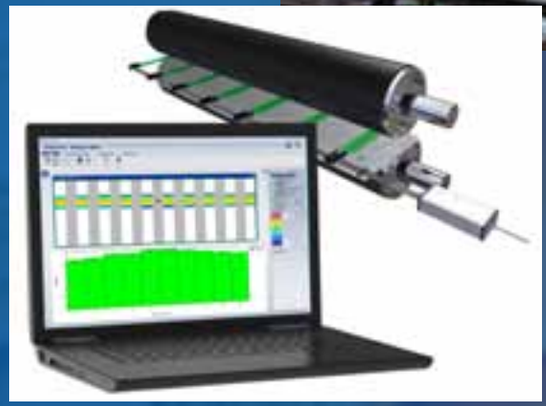


Figure 3
Real-time feedback from the NPAT to be left on the roller while a technician can see the impact of adjustments without having to re-enter the hazard area.

Other Similar Applications

- **High-Volume Printing**
- **Carpet Manufacturing**
- **Product Labeling**
- **Laminating**

Click Here to See NPAT in Action!

Troubleshooting Production Processes

Pressure mapping can help production personnel take the production journey, from assembly through completion.

As with any production facility, delicate materials often endure several impacts as they proceed through assembly. Using pressure mapping technology during routine maintenance and machine setup can help identify potential problem areas in a process.

CASE EXAMPLE: Enhancing Spot-Checking Efforts in High-Throughput Operations

Minimizing damage and loss in a high-throughput fill line operation is a major challenge for production managers and engineers. Visual inspection of bottles and containers for scuffs or damages only serves to identify that a problem has occurred somewhere in the process, but it may be physically impossible to determine where in the process these impacts happened.

Ultra-thin pressure mapping sensor technology is a useful method to enhance quality control checkups in fill lines, such as the machine shown in **Figure 4**. For instance, positioning sensors along rail lines or conveyors can capture pressure impacts and identify where adjustments could be needed. Also, instrumenting packaging units with sensors, and sending them through the entire production line, can also be an effective way to help service technicians pinpoint errors.

Figure 4
Pressure mapping output of impacts as bottles and containers advance through a fill line operation

Other Similar Applications

- **Machine Commissioning / Installation**
- **Vibration Testing**

INTEGRATED PRESSURE MAPPING SOLUTIONS

On-the-Fly Spot-Checking Features

Pressure mapping technology can quantify the effectiveness of a sealing process and optimize packaging design, run-after-run.

When packaging goods and devices, process consistency isn't just important for improving yields – it can, in some cases, quite literally mean the difference between life and death. With pressure mapping, manufacturers can stay in-tune with their machines in ways no other technology can provide.

CASE EXAMPLE: Identifying Packaging Defects On-the-Fly

As the previous examples of this eBook have shown, detecting defects in a manufacturing process is essential for keeping products fresh, sanitary, and free of damage. Embedding pressure mapping technology within a machine's U.I. can become a quality control measure that helps operators keep their products safe and secure.

Using a software API, Bonfiglioli Engineering, a pharmaceutical packaging machine manufacturer, integrated pressure mapping technology into an innovative blister pack testing machine.

As shown in **Figure 5**, the machine was designed with a pressure mapping sensor embedded within its lid. With a blister pack in place and the lid closed, the machine creates a vacuum across the chamber. If the seal on the blister pack is good, each pocket on the blister pack will expand in the vacuum, which is read by the pressure mapping sensor. If there is a leak, then air will get sucked out of the pocket, and its pressure mapping output will display the concave cavities, such as the "improper seal" output shown on the right. This invaluable information helped operators streamline their quality control checkups.

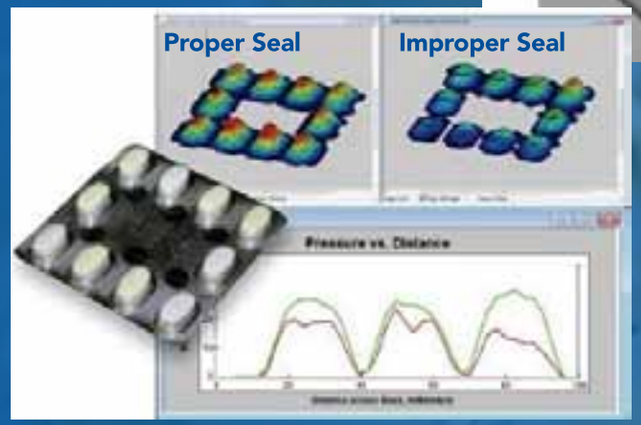


Figure 5
The Bonfiglioli pill pack machine includes a pressure mapping feature that identifies leaks in pill packs

Other Similar Applications

- **Ultrasonic Welding Machines**
- **Injection Molding**
- **Any Form, Fill, or Sealing Application**

Quantifying Robotic Performance

Machine setup and alignment is incredibly important when the machine's movements and actions can pose a danger to the operator.

Integrating pressure mapping capabilities into a machine can be an useful method to monitor machine performance, while also maintaining a safe working environment.

CASE EXAMPLE: Qualifying the Safety of Collaborative Robots

Collaborative robots (also known as Cobots) get their name because they are programmed to perform their functions while, in some fashion, collaborating directly with humans. Cobot systems are designed for a range of applications, and in many cases, they are installed in a production line without any safety caging.

Recently, a Cobot system manufacturer embedded pressure mapping capabilities into a new design to gauge the amount of force applied by its arm across different movements. The ultra-thin pressure mapping sensors were positioned on the robot's grippers to gauge pressure distribution as it handled objects.

With this real-time information, operators can be assured the Cobot design was functioning within its ideal baseline metrics, or be alerted if maintenance may be needed.

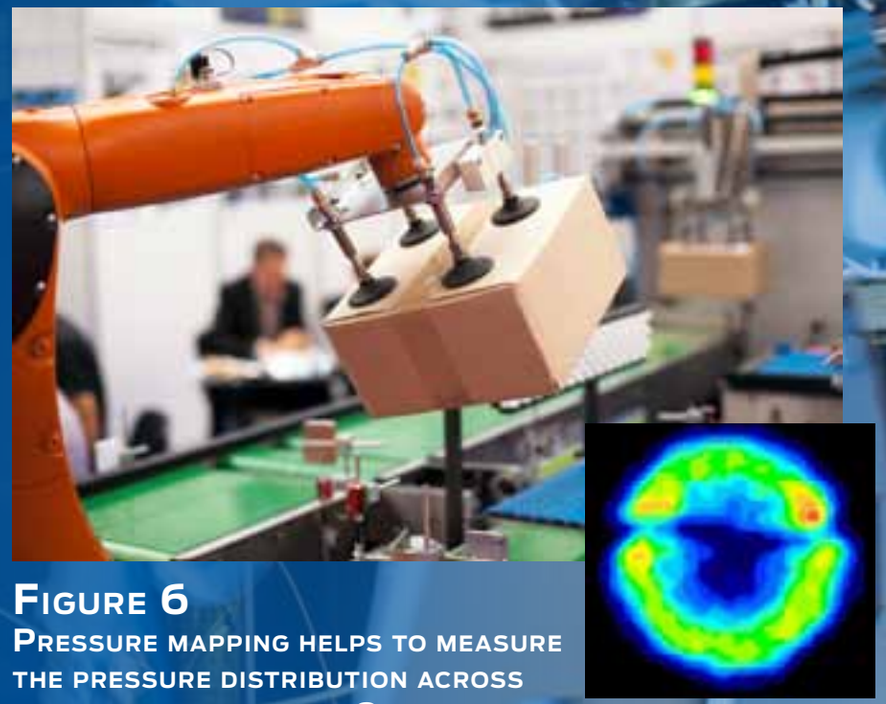


Figure 6
Pressure mapping helps to measure the pressure distribution across the contact area of a Cobot arm while it is in use

Other Similar Applications

- **Pick & Place Assemblies**
- **Robotic Welding, and Other Assembly**
- **Drone Delivery**
- **Automated Package Stacking Assembly Systems**

CONCLUSION

Let Us Help You Begin a Productive Conversation with Your Machine

The examples and successes shared in this paper are the result of an R&D team partnering with a trusted pressure mapping resource that could provide a solution to meet their specific goals. While every process is different, there are important qualities an R&D team should consider when selecting a collaborative partner:

1. **Experience & Longevity**: Does the company have a respected position in their market, and a proven track record of success?

2. **Mastery of the Technology:** Is the company continuously delivering new innovations and improvements to their technology?

3. **Proven & Diverse Application Portfolio:** Has the company demonstrated several examples where they were presented with unique challenges and developed value-added solutions?

Let's discuss your next pressure-specific manufacturing application.

We at Tekscan understand the challenges R&D teams face, and the risks they take when investing in test & measurement technology. Whether it's a standard pressure mapping system, or a custom solution, Tekscan has a proven track record for helping R&D teams achieve a better understanding of their products and procedures by providing trustworthy, actionable data. Your return on investment comes in the form of confidence in your product design, a shortened development process time, and an improved end-user experience.

Visit www.tekscan.com or call 1.617.464.4282 for more information.

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