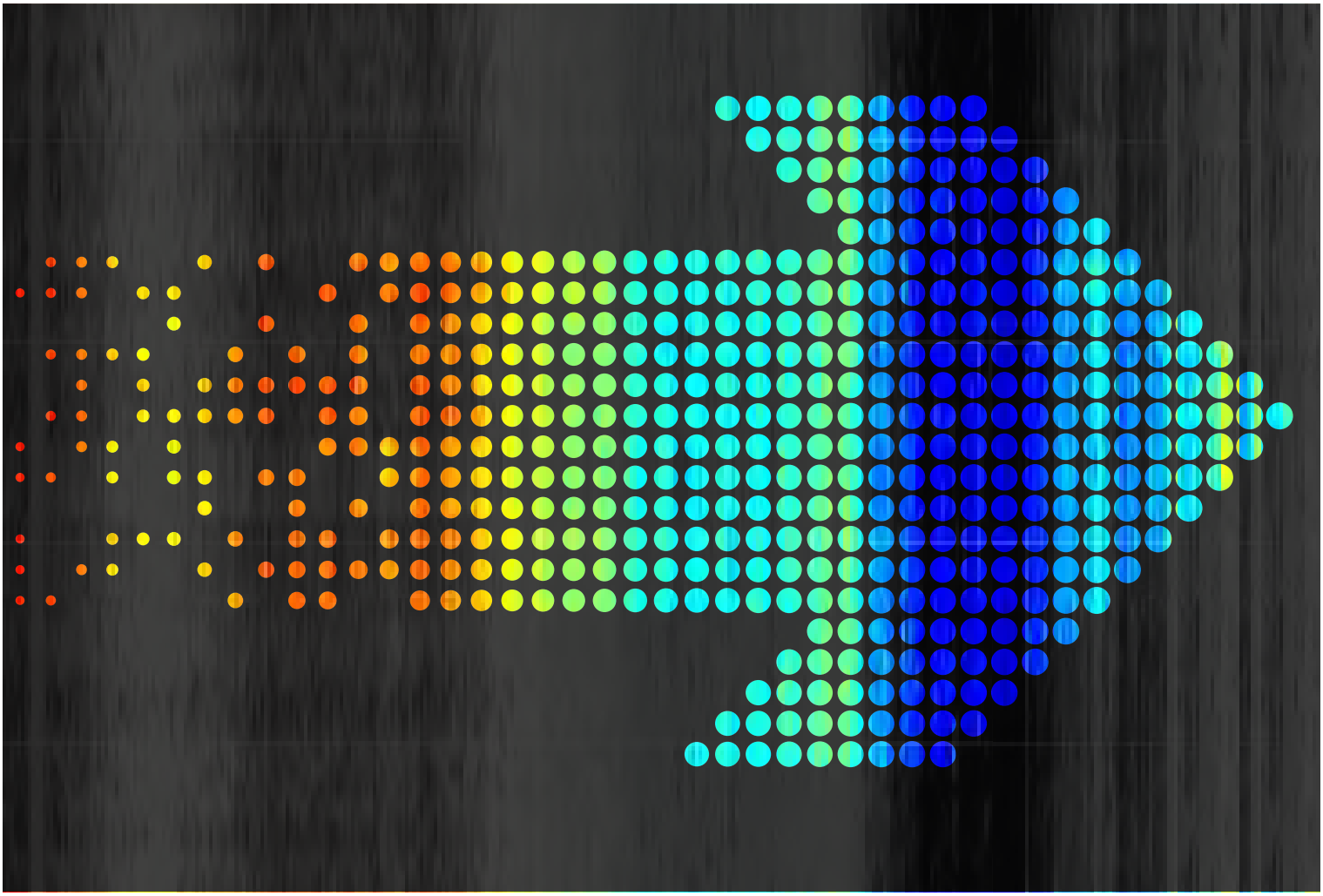
Plant Services
SPECIAL REPORT

The revolution and evolution of industrial acoustic imaging



Sponsored by

FLUKE

The revolution and evolution of industrial acoustic imaging

Revealing unseen and unheard air and gas leaks is becoming faster and easier

The race to automate has firmly taken hold in industrial condition monitoring. Accelerated by the COVID-19 pandemic, plants are actively seeking new ways to improve maintenance efficiency, productivity, safety, and quality while reducing costs and strengthening the bottom line.

One of the more active area of research and development is acoustic imaging. Born of the necessity to minimize costly compressed air leaks, acoustic imaging marries sound and sight technologies to pinpoint leaks by visually depicting sound levels (dB) and frequencies (kHz). Though air leaks are generally invisible, they do emit audible or ultrasonic sounds. Distinguishing the sound amid the din of industrial processes is a challenge that acoustic imaging overcomes.

Its success in identifying leaks in compressed air systems has been extended to gas, steam, and vacuum leaks, mechanical anomalies such as failing bearings, and leaks in products coming down the production line.

Along the way, industrial acoustic imaging technology evolved and improved. Initial, portable instruments led to versions with higher capabilities, and now there are complete continuous monitoring solutions that generate alarms in real-time and have networking capabilities. The latest impressive iteration has imagers mounted on drones and mobile robots.

PERVASIVE CHALLENGES DROVE EARLY SOLUTIONS

Because of the high cost of compressed air, companies go to great lengths to detect and correct leaks. The effects of leaks ripple across plant in the form of pressure losses that reduce tool effectiveness and slow down production; faulty, inefficient drive systems that consume additional power to remain operational; energy losses; unplanned downtime, fugitive emissions; health and safety hazards; and all the substantial associated costs.

Before acoustic imaging existed, leak detection was time consuming, repetitive, often messy, and limited in accuracy. Soap bubble tests, handheld sniffers, and assigning humans to manually listen for audible sounds are labor-intensive approaches that allow many leaks to slip through the cracks, if plants do anything at all.

The introduction of portable acoustic imaging for air-system condition monitoring was revolutionary and the solutions proved hugely successful. Suddenly, technicians could quickly locate leaks simply by pointing the device at an asset or system or scanning a large area – from a safe distance, with the line still running, and no matter how noisy the plant. Seeing the sound in context coming from hoses, fittings, or connections allowed them to quickly make corrections and considerably reduce costs (see Figure 1).

Figure 1. With portable acoustic imagers, technicians can quickly locate compressed air leaks simply by pointing the device at an asset or system or scanning a large area – from a safe distance, with the line still running, and no matter how noisy the plant.

For instance, leaks can be detected in minutes and entire plants can be inspected in hours, during peak operations, with the Fluke ii900 Industrial Acoustic Imager. Launched in 2019, the imager uses SoundSight™ technology to show leaks by visualizing them as a steady red spot. It isolates the sound frequency by filtering out background noise and presents a combined SoundMap and visual image that identifies the source of the leak. Saved images can be exported for reporting.

By 2020, a higher-resolution model, above 50 kHz, was released for partial discharge (PD) detection and testing applications. The Fluke ii910 Precision Acoustic Imager also detects corona discharge and small, low-pressure, or low-density leaks with its greater sensitivity. It enables timely repairs, increased uptime, energy and cost savings, and lower fire risks, and PD data can be captured and analyzed in a machine learning reporting platform.

BIRTH OF CONTINUOUS ACOUSTIC IMAGING

The success of the portable technology drove development of fixed, continuous monitoring solutions. This significantly extended the possibilities of automated leak and anomaly detection and enhanced factory safety by further minimizing operator intervention. It appeals to major industries such as energy, utilities, automotive, food and beverage, metals, mining, building materials, aerospace, and semiconductor plants.

Fluke Process Instruments has been beta testing its new SV600 Fixed Acoustic Imager for 24/7 detection of air and gas leaks and mechanical anomalies this year and is launching the product in October. Condition monitoring technicians can "set it and forget it" in strategic operational areas and spend more time on other value-added tasks while the imager continuously detects, locates leaks in context, and visualizes sound signature changes (see Figure 2).

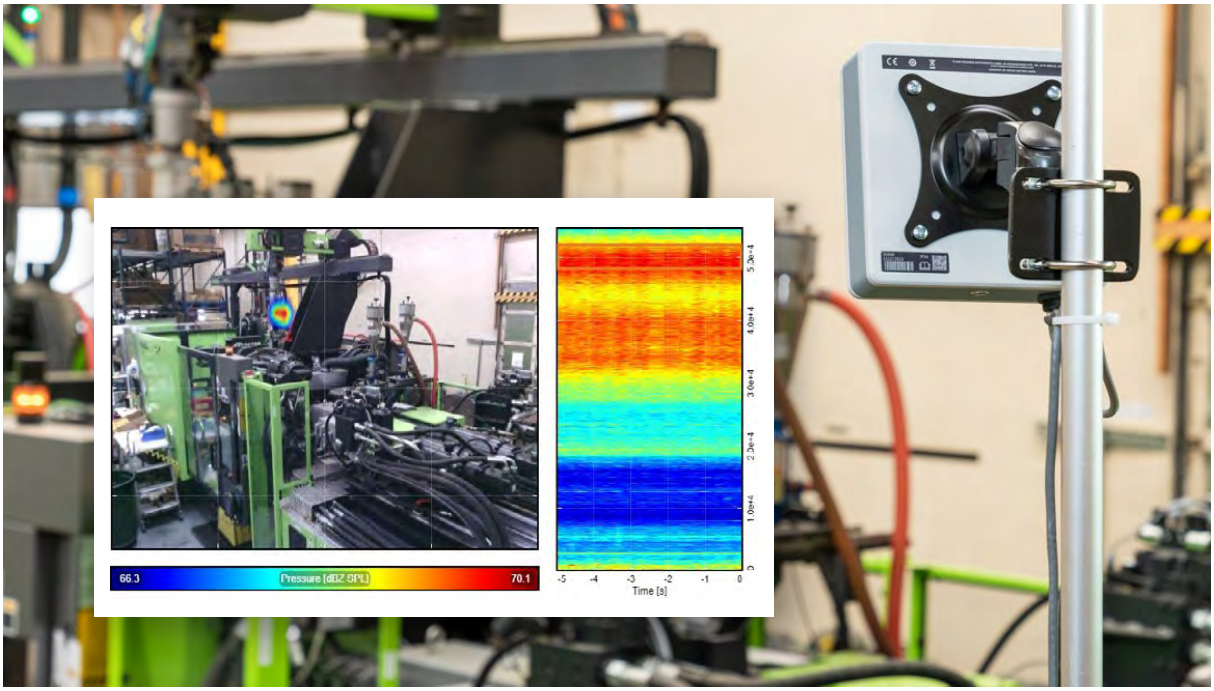


Figure 2. Condition monitoring technicians can use the new new SV600 Fixed Acoustic Imager to continuously detect and locate leaks in context, while the technicians spend more time on other value-added tasks.

"The SV600 will have the ability to network multiple sensors to expand the SoundMap and simultaneously analyze numerous areas of interest," explains Simon Powell, business unit leader at Fluke Process Instruments (www.flukeprocessinstruments.com). "We can set an event on an inspected and learned sound for an abnormality and set an alarm to occur."

The fixed solution supports three popular workflows:

1. **Process and equipment monitoring:** Companies wanting to monitor entire equipment areas or restricted and dangerous areas for air and gas leaks benefit from fixed acoustic imaging for continuous asset and process monitoring. The technology also picks up noise signature changes in failing equipment, such as when bearing wear and fatigue start to materialize.

   The insights are game changers for predictive and prescriptive maintenance (PdM/RxM). With real-time monitoring and immediate alerts of new sound events via user-programmable alarms, technicians can take proactive steps to prevent expensive failures and unplanned downtime. Costs are further slashed by reducing consumption of compressed air and energy. "ROI can be achieved in just the first week. In some cases, customers are purchasing units to monitor several key assets in their facility," says Powell.

2. **Product inspections:** Companies that test products on the production line for air leaks can increase accuracy, safety, productivity, and product quality by using fixed acoustic imaging. Instead of testing new radiators by submerging them under water and creating slip hazards, listening to plastic welded products for an audible noise when pressure is applied, or listening during a pneumatic brake test for anomalous sound signatures, acoustic imagers can perform the inspections and quality assurance processes automatically.

   The SV600 can be mounted close to the production line or conveyor belt. Using factory integration and real-time alarm features, it can immediately send notifications of quality issues and product rejects. With a fully digitized process, data can be recorded and archived to improve product traceability.

3. **Mount and move:** When acoustic imagers are mounted on drones or mobile robots, automated equipment and facility inspections can reach more areas of the operation. Drones equipped with an acoustic imager payload can aerially inspect large facilities and remote assets such as power lines. Mobile robots bearing an acoustic imager can conduct daily maintenance walks.

   A new partnership with Boston Dynamics, announced in July 2021, couples its dog-like

In-demand acoustic imaging workflows:

- Process and equipment monitoring
- Product inspections
- Mount and move

With acoustic imaging, gas leaks can be detected in minutes, and entire plants can be inspected in hours during peak operations.

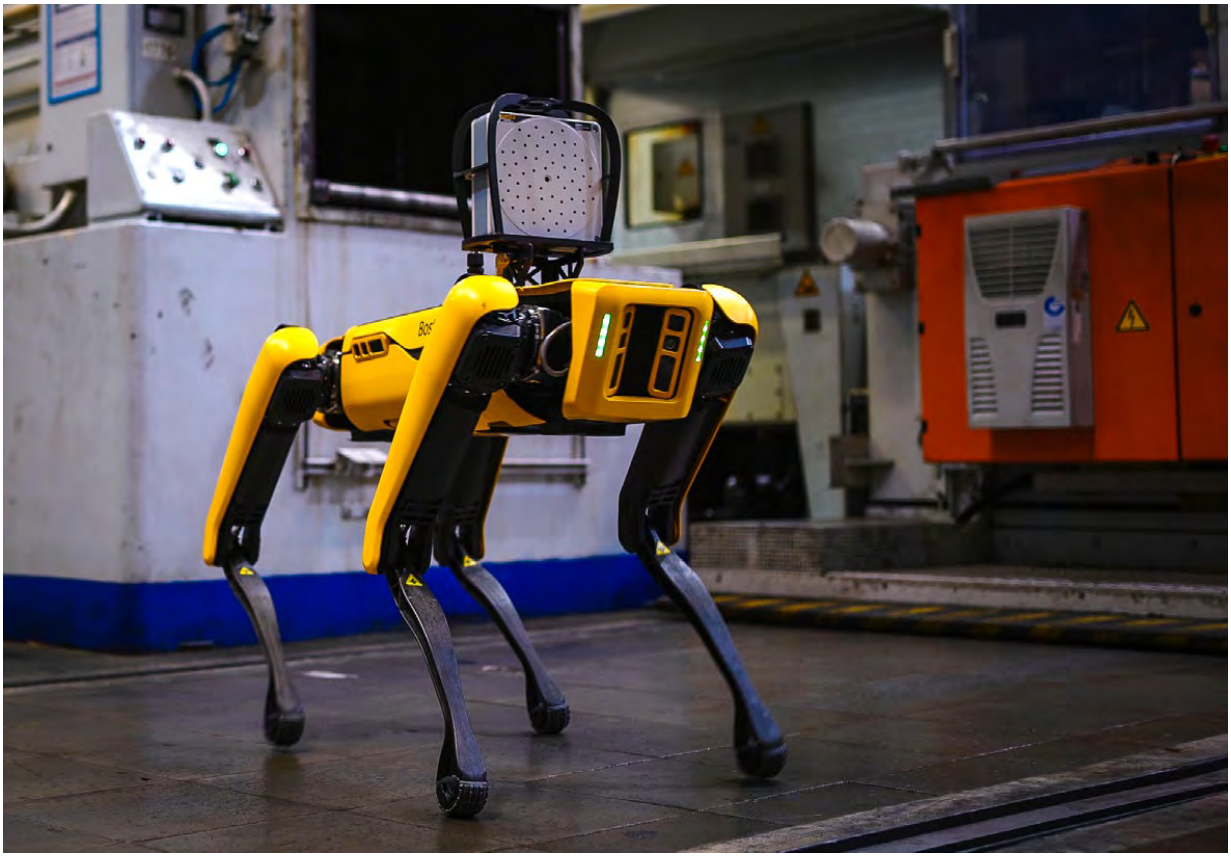


Figure 3. A new partnership with Boston Dynamics, announced in July 2021, couples its dog-like agile mobile robot Spot with the SV600 payload.

agile mobile robot Spot with the SV600 payload (see Figure 3). "It is already generating significant interest from large-scale plants and facilities, including a global beverage company, major mining company, and large energy companies," says Powell. "The value is in automating routine inspections so it's all about worker efficiencies."

At the end of the maintenance walk, the SV600 provides notification of potential issues regarding leaks or anomalies. The maintenance team can then investigate and act on them in a timely, planned manner.

Besides standalone support for PdM, RxM, and inspections, acoustic imaging pairs well with other condition monitoring technologies such as thermal imaging, vibration analysis, and oil analysis. Additionally, fixed and portable acoustic imagers complement one another. The Fluke portable tools (ii900 series) work in tandem with the SV600 and are ideal for inspections or monitoring assets that require intermittent rather than 24/7 monitoring, or capturing different angles in more detail if needed, and verifying that repairs are successful.

With further advancements underway, acoustic imaging is sure to remain a significant player in condition monitoring and inspection automation.