## **Problem:**

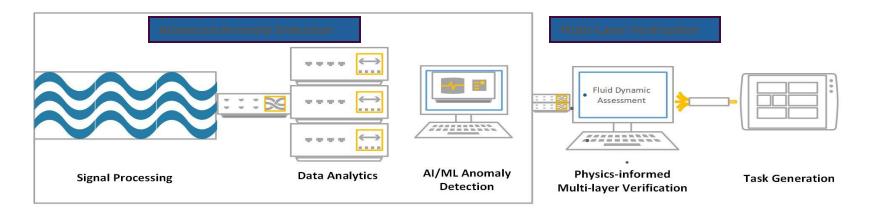
- Point sensors (mass balance, CPM) may not have sufficient resolution and precision as it is limited by sensor location(space)
- Periodic inspection(ILI, Drone, smart pigs) may not be deployed at right time

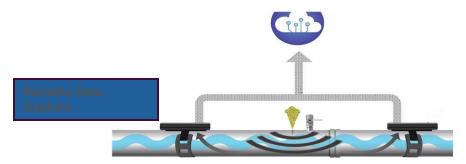
# Distributed Acoustic Sensing(DAS) provide options to overcome both challenges using the flow as effective signal carrier.

## **Solution:**

Distributed Acoustic Sensing(DAS) provide options to overcome both challenges using the flow as effective signal carrier.

- DAS provide potential for 24/7 monitoring(no time limit),
- DAS provides solution 100% coverage (no space constraint) using flow as signal carrier
- AI/ML and physics informed verification minimize the sensitivity and false alerts





**Distributed Acoustic Sensing(DAS)** 

## **Empower Data-Driven / Low-Latency Decision Making**



# **Customized Sensor Solutions**

- Non-intrusive sensors for High fidelity data capture
- Agile / Scalable Monitoring solution



### AI/ML-Driven Analytics for Intelligent Monitoring

- Cutting-Edge Signal Processing for Superior Data Insights
- Integrated AI/ML Models for Real-Time Anomaly Detection and Rapid Response



### Physics-informed Automated Alert Verification

- Integrated Flow reconstruction model
- Low-latency through reduced order modeling

# Key Advantages

#### **Non-Intrusive Sensor**

- Instant Deployment: Clamp-on sensors enable quick, hassle-free installation—no complex fiber optic setups required.
- Zero Disruptions: No downtime, no cutting or welding—seamless integration for new and existing facilities.

#### **Distributed Sensing**

- Eliminates Timing Gaps: Continuous high-fidelity monitoring ensures real-time insights, eliminating the "Time" challenge.
- Closing the Sensing Gaps: Distributed sensors capturing critical data before it dissipates, eliminating the "Space" challenge.

### **Advanced Signal Processing**

- Physics-Driven Intelligence: Leverages energy modes and entropy analytics to enhance flow pattern recognition.
- Precision Anomaly Detection: Signal processing rooted in physics insights ensures reliable anomaly identification.

### **Multi-Layer Verification**

- Physics-Informed Verification: Reconstructs flow dynamics using advanced models validating alerts with real-world physics.
- Intelligent Alert Filtering: Minimize false alarms by cross-verifying anomalies against a physics-based flow reconstruction.

<b>Traditional</b>	l Sensing System

- Distributed sensing not feasible
- Sensor installation risks pipeline integrity for cut and weld
- Adding datapoint is costly and disrupt operation

## Fiber Optic Cable(FoC) Drawbacks

- High Capex and Opex
- Fragile- Single Break halts monitoring system
- Build on structural wave sensing lacks the capability of flow-reconstruction

## Innovative Sound-to-Insight Model for Lower Cost of Ownership

- Easy-to-Install Clamp-on Sensors enable quick integration with minimum interruption—achieving scalability without compromising integrity
- Adds data points effortlessly to enable precision flow insights and optimize performance
- Leverages flow reconstruction to unlock a new dimension of operational intelligence and efficiency
- Empowers proactive maintenance through advanced signal processing—enhancing asset reliability and uptime.