

# Remote Oil and Gas Pipeline Monitoring

## Using Resensys Wireless SenSpot™

Remote oil and gas pipeline monitoring ensures the safety and integrity of critical energy transportation systems. With Resensys Wireless SenSpot™ Sensors, operators can achieve real-time insights and long-term monitoring to mitigate risks and optimize operations. Key monitoring capabilities include:

- **Monitoring stress and loads on pipelines**
- **Tracking settlement and inclination**
- **Detecting leaks, infiltration, and moisture**
- **Vibration monitoring for seismic and operational events**

This application note explores the deployment of Resensys wireless monitoring technology for oil and gas pipelines, offering a cost-effective, scalable, and reliable solution to enhance pipeline integrity and ensure operational efficiency.

**Oil and gas pipelines** are transportation systems used for energy purposes. Pipelines are one the most common and efficient ways to transport large quantities of oil and gas are recognized as one of the safest and cost-effective solutions.

There is more than 2.5 million kilometers of hydrocarbon pipeline spread across the world. These pipelines are usually damaged as a result of natural wear and tear, operator system errors, natural events (seismic events, extreme weather condition, erosion, earthquakes, etc.) or due to third party activities (explosions, drilling activities, vehicular movement, vandalism, etc.).<sup>1</sup> Leakage or breakage could result in substantial damage and harm to the environment. To avoid pipeline damage, continuous and reliable pipeline monitoring is necessary. Transport facilities in the oil and gas industry must be monitored for structural integrity to ensure the safety of everyone involved, protect the environment, and guarantee the quality of production.

Also, the oldest pipelines (aged 15-20 years or older) have a generally higher likelihood of accidents; thus, the significance of pipeline monitoring increases.

The very important quantities that should be monitored in existing oil and gas pipelines are strain and tilt. For areas that are identified as critical, monitoring of the ongoing condition of the line is of paramount importance. The most effective technique of monitoring the local pipeline condition is using Strain Gauge SenSpot™ and Tilt SenSpot™ (Inclinometer) sensors. All [SenSpot™](#) (including tilt and strain gauges) provide temperature readings. Thus, this method also records temperature measurements to be conducted at the same time.

[Wireless high-resolution tilt SenSpot™ sensors](#) have been designed to assist authorities with this application. These sensors are able to be installed on and within oil and gas pipelines surfaces and sections, and they are capable of monitoring inclination of pipeline surfaces with exceptional precision

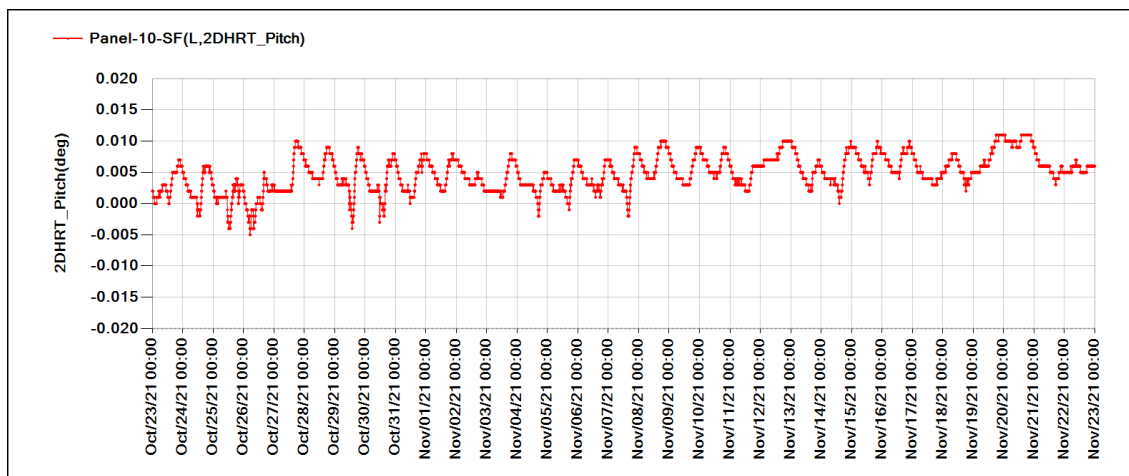
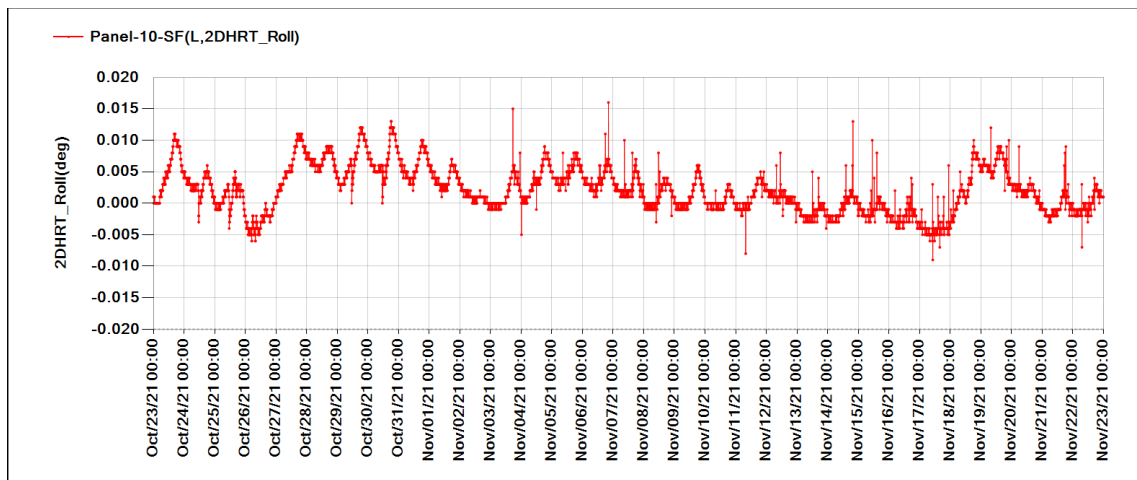
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<sup>1</sup> Aba, E. N., Olugboji, O. A., Nasir, A., Olutoye, M. A., & Adedipe, O. (2021). Petroleum pipeline monitoring using an internet of things (IoT) platform. SN Applied Sciences, 3(2), 1-12

(0.00016 degrees or 0.5 arcseconds), which allows for complete conditional awareness and remote monitoring of pipeline.



Wireless high-resolution tilt SenSpot™



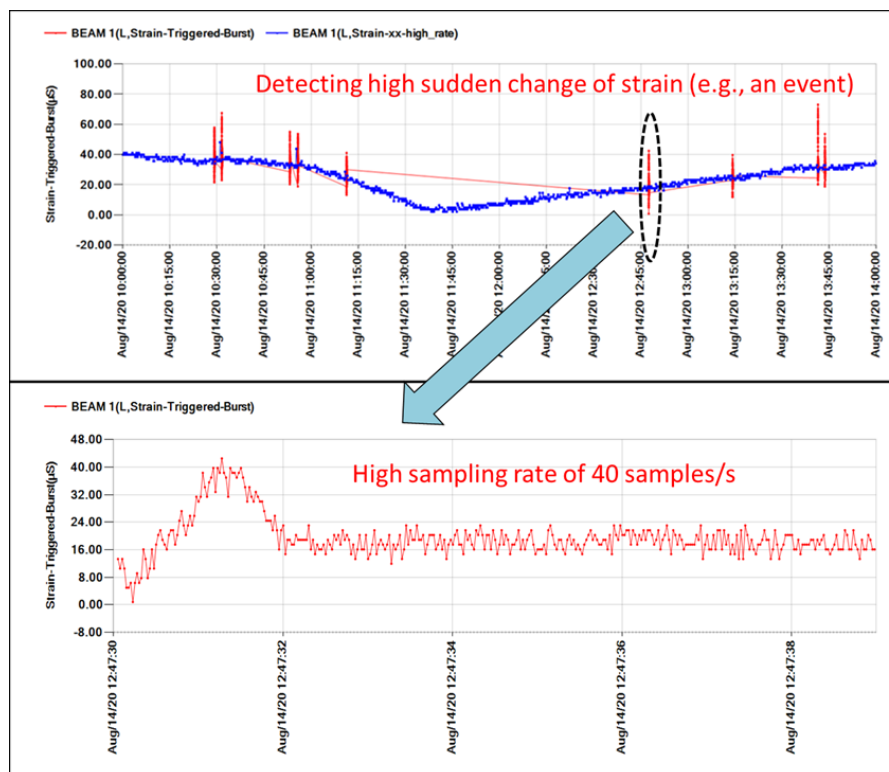
## High-resolution tilt measurements (2D-roll & pitch) in SenScope™ software for an installed HRT gauge (High-Resolution Tiltmeter, Inclinometer) on a section of gas pipeline

Resensys [Wireless Strain Gauge SenSpot™](#) sensors are well-suited for monitoring oil and gas pipelines because of their continuous, accurate data collection, high rates of strain data transmission and their ability to withstand harsh/ extreme weather conditions. They are wireless, and low-power, meaning that they are easy and cost effective to install and maintain, particularly in remote areas. They have adjustable triggering threshold and sampling intervals and provide accurate and reliable results, without need for calibration in the field.



### [Resensys Wireless Strain Gauge SenSpot™](#)

Furthermore, triggered-burst technology of the Wireless SenSpot™ sensors can detect any High-rate events for different kind of structural quantities. This technology collects 20-100 samples per second. For instance, as it is seen in graph below, High-strain events corresponding data (Strain-Triggered-Burst) can be shown with all collected strain data.



Strain (Blue) and Strain-Triggered-Burst (high-strain events) (Red) measurements of an installed Wireless Strain SenSpot™ sensor on a surface of an oil pipeline



Resensys wireless strain gauge SenSpot™ and wireless high-resolution tilt SenSpot™ on a section of the pipeline

The Resensys cutting-edge **wireless** technology and tools provide **cost-effective** solutions to meet any requirements of the oil and gas utility monitoring outlined by the following benefits and unique features:

- **Wireless Tilt and Strain Gauge SenSpot™ Sensor:** No wiring, minimal lane closure for installation
- **Sensors with 10+ Years Battery Life:** No need for battery replacement, maintenance or calibration in the field
- **Easy Installation:** Self-adhesive (e.g., steel) or Flange-mount (e.g., concrete)
- **Quick Testing:** Can be installed for short-term testing, easy to remove and reuse on other structures/pipelines and applications
- **Long-term Monitoring:** Designed to be used for long-term monitoring (e.g., several years).
- **Small Size and Lightweight**
- **Being Suitable for Different Kind of Materials:** Can be used on steel, concrete, steel, timber, and composites
- **Rugged, Weather Proof and Corrosion Resistant:** Can operate in rain, snow, ice, high humidity, salty environment and extreme weather (-40°C to +65°C or -40°F to +150°F).
- **Infrastructure Less:** Battery Operated, Energy self-sufficient, No need for communication infrastructure at the pipelines
- **Provide Data Visualization and Data Analysis**
- **Provide Alert Services:** Alert generation and management with customizable alert levels, automated structural diagnostics, capability of providing e-mail or text message alerts
- **Very High Resolution for Wireless Tilt SenSpot™:** 0.00016 degree or 0.5 arcseconds
- **Very High Resolution for Wireless Strain Gauge Sensor:** 1-μStrain resolution

This system reduces installation cost and time for owners/authorities to get the real-time data they need for oil and gas pipelines monitoring. A unique capability of Resensys wireless gauges is to measure at very high precision, while providing ultra-low power usage to allow short and long term monitoring.

A typical Oil and Gas Pipeline Monitoring system includes the following components:

- **[Wireless SenSpot™ Sensors and Devices](#)** are attached to surface or section of pipelines. The number of gauges required per project is usually dependent upon the design, existing issues/damage on members/section/surface, and client-specific needs:
  - [Wireless Strain Gauge SenSpot™ Sensor](#)
  - [Wireless Tilt/Inclination SenSpot™ Sensor](#)
  - [Wireless Accelerometer SenSpot™ Sensor](#)
- **[SeniMax™](#):** a wireless data logger gateway that is connected to the cellular or satellite networks; it wirelessly collects SenSpot™ data at the site and sends it to a cloud database server (one SeniMax™ can cover as many as 100 SenSpot™ sensors and devices within its wireless communication range).
- **[SenScope™](#):** software for data analysis and visualization, data export, automated alert management, thermal analysis, and pipeline data analysis. For pipeline monitoring, Resensys SenScope™ has the feature to provide alert notifications when pre-set data thresholds have been exceeded (by sending warning email/text/notification to corresponding authority).

The figure below shows a picture of a practical Resensys remote monitoring system, which can be used for Oil and Gas Pipelines Monitoring.

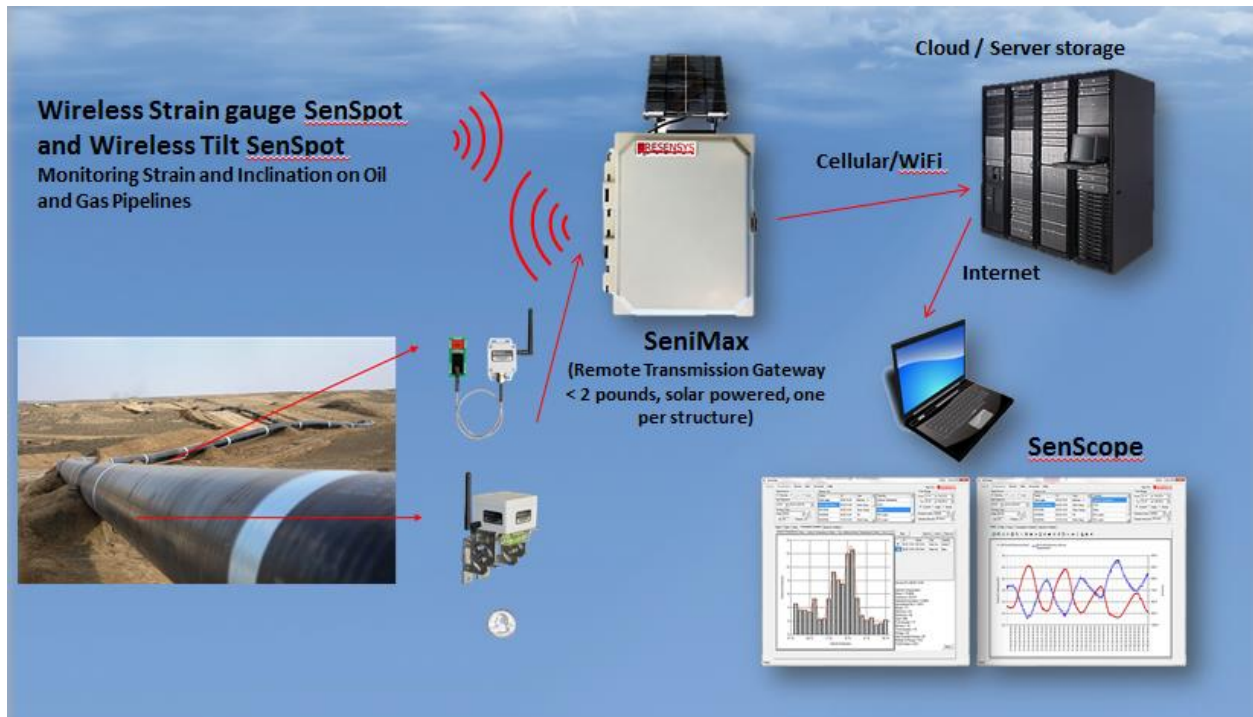


Illustration of Resensys remote monitoring system based on SenSpot™ sensors for monitoring the Oil and Gas Pipelines