Ultrasonic guided waves have become a viable option for the rapid inspection of buried, insulated, or otherwise inaccessible piping in the nuclear, fossil, and oil & gas industries. The primary advantage of Guided Wave Testing (GWT) is its ability to remotely detect and locate corrosion, so we can provide reductions in both inspection time and cost. We complete Guided Wave Testing (GWT) by placing a collar array of transducers on the pipe and exciting a low-frequency ultrasonic wave that is guided by the boundaries of the structure and propagates along the axial direction of the pipe. When the guided wave impinges upon a reflector, such as a weld, flange, or corrosion, some of the energy is reflected back toward the transducer array where it is received and analyzed. Depending on the application, the length of pipe inspected is commonly within the 50ft to 500ft range.

Figure 1. Using GWT, inaccessible areas can be examined from a single access point. For example, in the photograph above, a buried section is being examined from an exposed section of the pipe.

GWT ADVANTAGES
- Proven Technology
- Long Range
- Inaccessible Piping
- 100% Volumetric
- Cost Effective NDE
- Minimal Surface Preparation
- Severity Assessment

GWT APPLICATIONS
- Road/Rail/River Crossings
- Above-Ground Piping
- Cased Crossings
- Buried Piping
- Corrosion Under Insulation
- Corrosion at Supports
- Touch-Point/Crevice Corrosion
- Weld Location
- Permanent Installation Monitoring

SENSITIVITY
GWT technology is capable of predicting the percentage cross sectional area (CSA) reduction from a given indication. Figure 3 illustrates the CSA reduction concept. Line geometry, the presence of any external or internal coatings or liners, and the general condition of the piping are the primary factors that dictate the achievable sensitivity for a given application. GWT focusing concepts can be used to estimate the circumferential extent of an indication and in some cases improve the achievable sensitivity.

Figure 2. Comparison of inspection coverage for GWT and conventional UT inspection. (Red shaded area indicates inspection coverage)

Figure 3. Examples of equivalent cross-sectional area reductions with varying circumferential extents.

FREQUENCY TUNING STANDARD AT STRUCTURAL INTEGRITY
Guided wave frequency tuning (i.e. collecting multi-frequency data) concepts have been proven for enhancing guided wave assessment confidence. This is because sensitivity is a function of frequency and defect geometry, with some geometries being detected at high frequencies and others at low frequencies. Furthermore, some frequencies provide better penetration power, especially for the case of buried piping with coal-tar based coatings. Frequency tuning is standard procedure for Structural Integrity and all GWT equipment used in our services has this capability.
GWT FOCUSING

Structural Integrity uses modern GWT tools that now have the ability to actively or passively focus guided wave energy at a specific axial and circumferential position. Figure 4 illustrates the difference between a focused inspection and a traditional axisymmetric inspection. With active focusing, concentrated wave energy is delivered to the focal point, increasing the signal-to-noise ratio, and consequently the sensitivity, at this location. We use active focusing to improve penetration power in some applications; however, new data must be collected for each desired focal point. With passive focusing, many focal points can be calculated very quickly via post-processing of the data, allowing for the generation of a representative image of the pipe, as shown in Figure 5. However, it does not send more energy to the focal point than the conventional axisymmetric inspection approach.

Figure 4. Demonstration of guided wave axisymmetric (Top) and focusing (Bottom) inspection concepts.

Figure 5. Resultant pipe image generated by passively focusing guided wave energy at many axial and circumferential locations. The horizontal axis is the axial location of the indication relative to the tool and the vertical axis is the circumferential position. In this case, there was no corrosion in the pipe.

APPLICABILITY

GWT was originally developed to inspect for corrosion under insulation and is commonly applied to pipe with diameters ranging from 2” to 60”. For this application, inspection distances can often reach several hundred feet. When we use it in buried pipeline, inspection range and damage detection sensitivity is dependent on the coating type and thickness and, in some cases, the type of soil in which the pipe is buried. Inspection distances for heavily coated and/or buried pipe can be significantly reduced as compared to above-ground lightly-coated pipe and are often in the tens-of-feet range. While guided waves are able to propagate for very long distances, they cannot propagate past large reflectors, such as flanges, couplings, tees, etc. and these features typically mark the end of the test range.

STRUCTURAL INTEGRITY’S ADVANTAGE

Structural Integrity added three of the major guided wave testing (GWT) technologies to our inspection capabilities and are the first and, presently, the only service provider capable of such an offering.

Whether it be the PowerFocus®, Wavemaker, or Teletest Focus® long-range pipe inspection equipment, we will bring the right equipment for the application.

We employ industry leading experts in guided wave technology, the most highly and diversely qualified technicians, and have formed a strategic alliance with FBS, Inc. for the development of new GWT solutions. We also provide comprehensive engineering solutions for the nuclear, hydro and fossil power generation and oil and gas industries. Look to us for innovative products and solutions, world-class responsive service, first-time quality and industry-leading engineering experts.