

UMI SCANS OF PIPES WITH ELBOWS



FMMS 2026

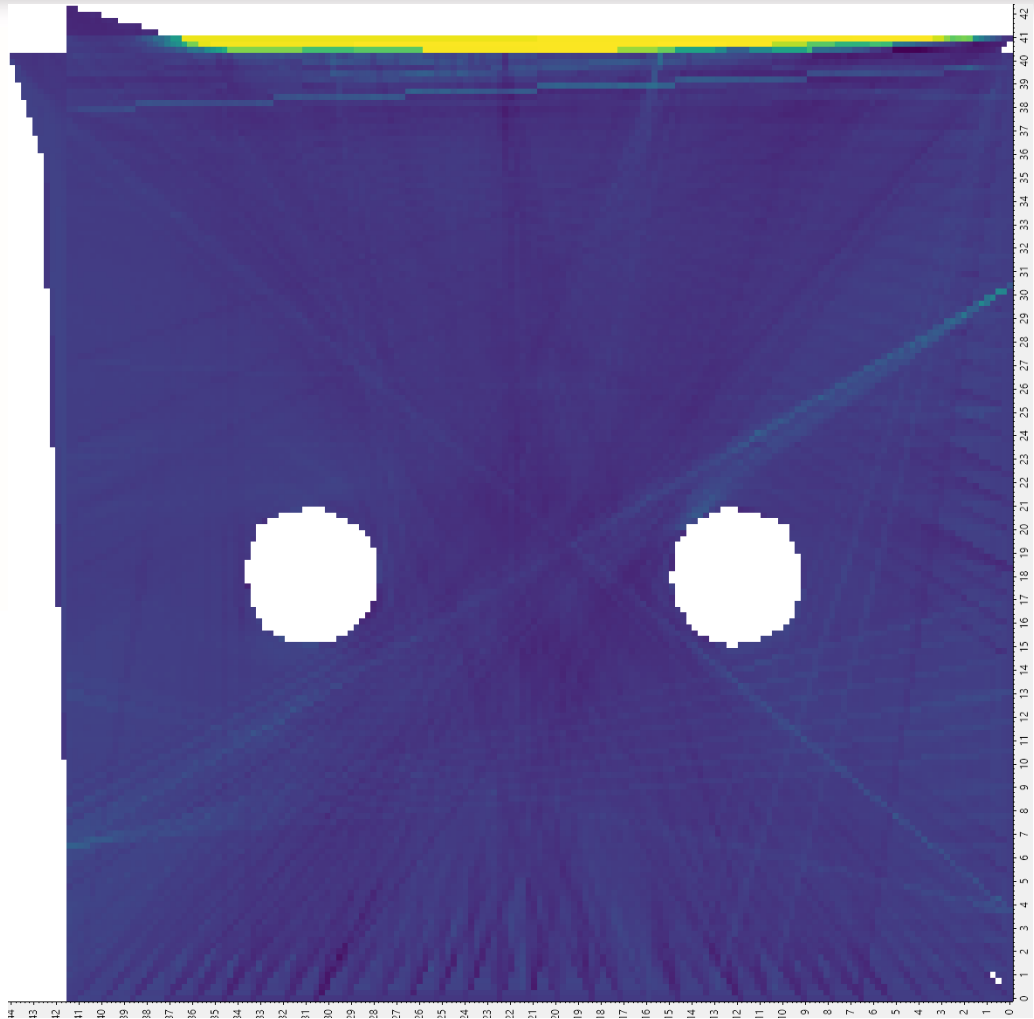
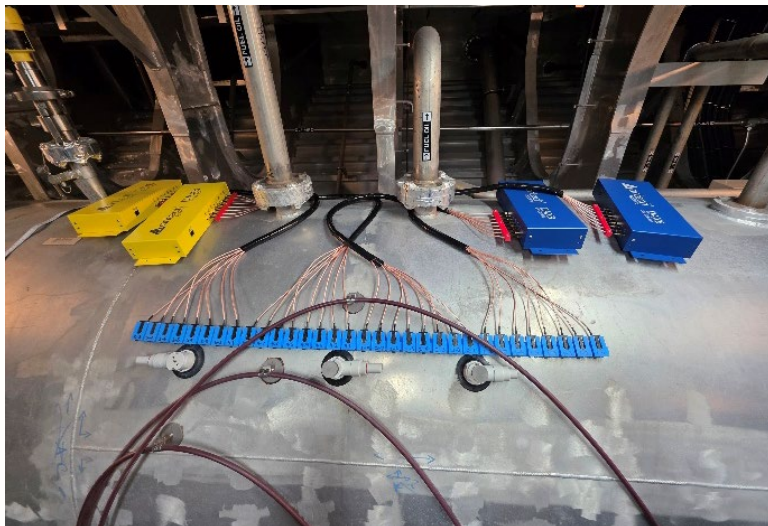
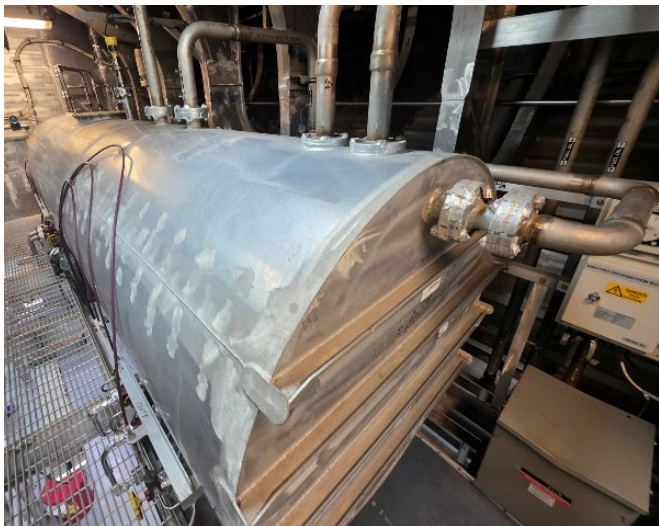
23 September 2026

Antech Team

► AGENDA

- ▣ Plates
- ▣ Wrapped Plates (Pipes)
- ▣ Bent Wrapped Plates (Elbows)
- ▣ Solving the tomography
- ▣ Initial testing

► TEST LOCATION



► FIELD TESTS - PLATES

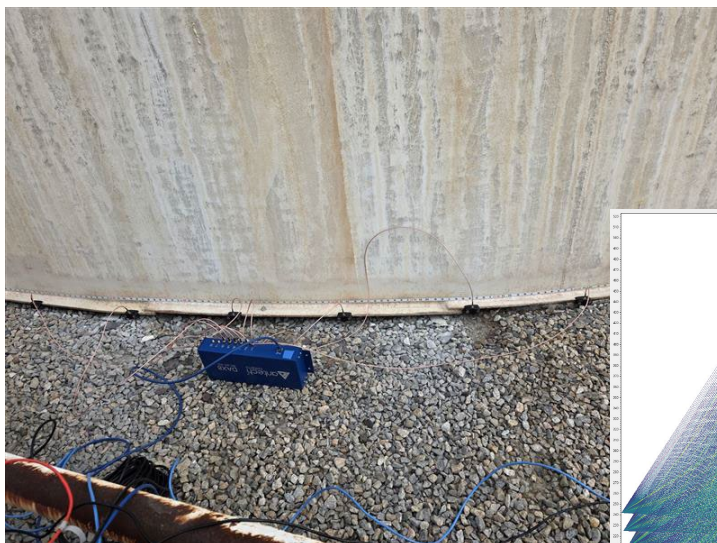


5 foot by 20 foot, 1" thick plate

Submarine hull

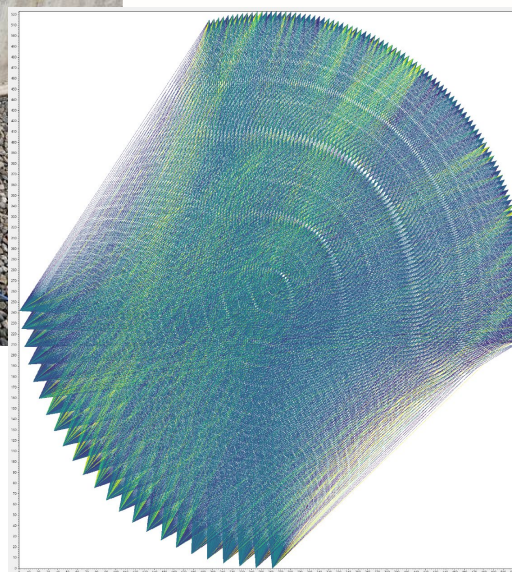


► AST NON-INVASIVE TANK BOTTOM SCANS

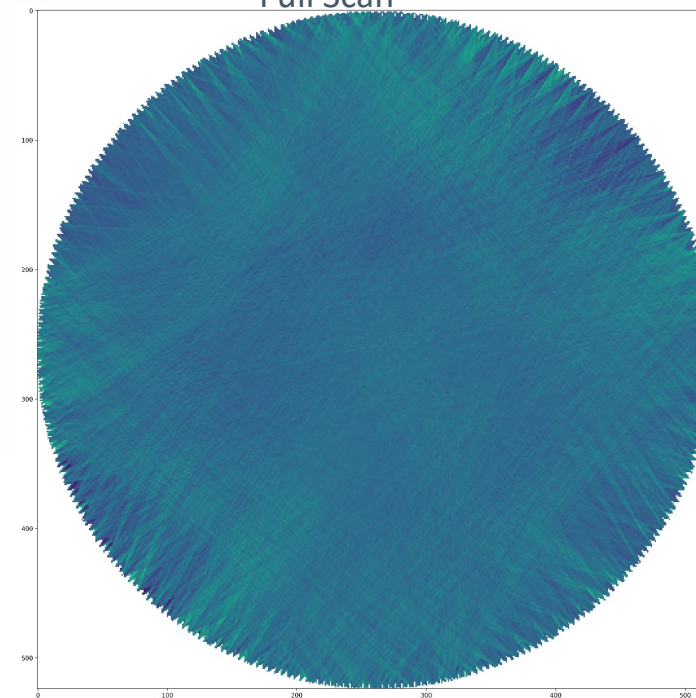


46-Foot Diameter Tank

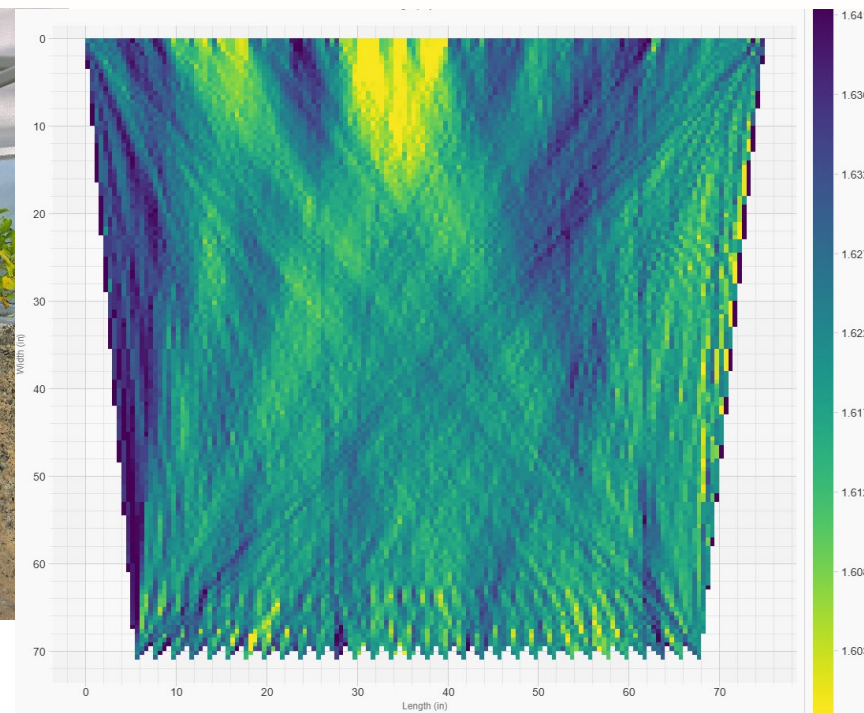
90 Degree Scan



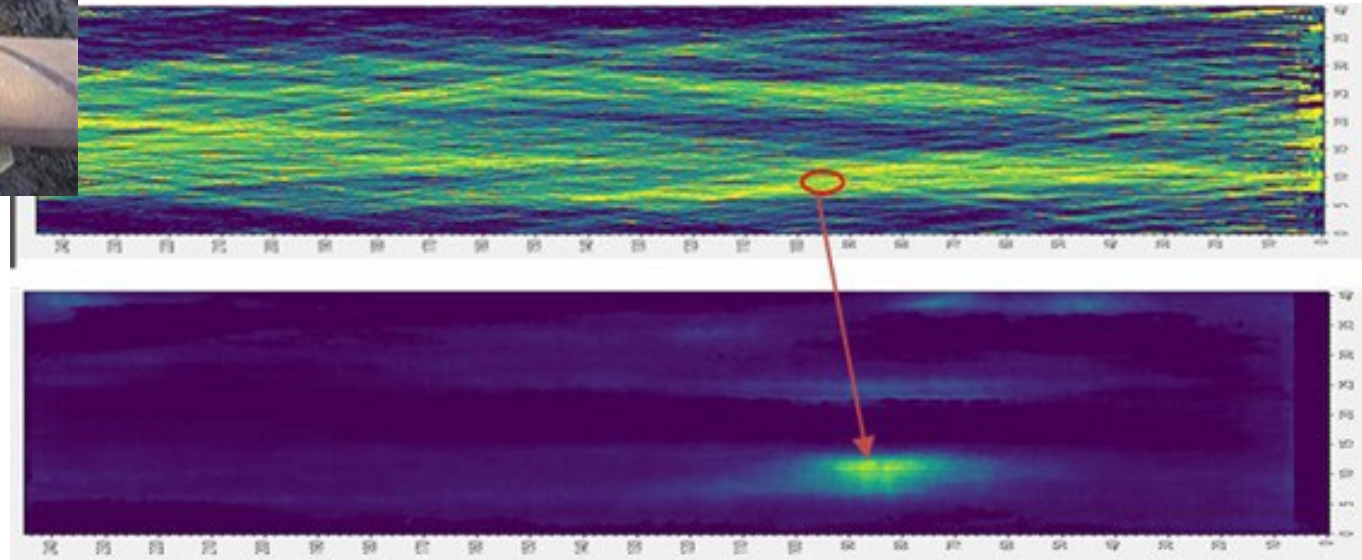
Full Scan



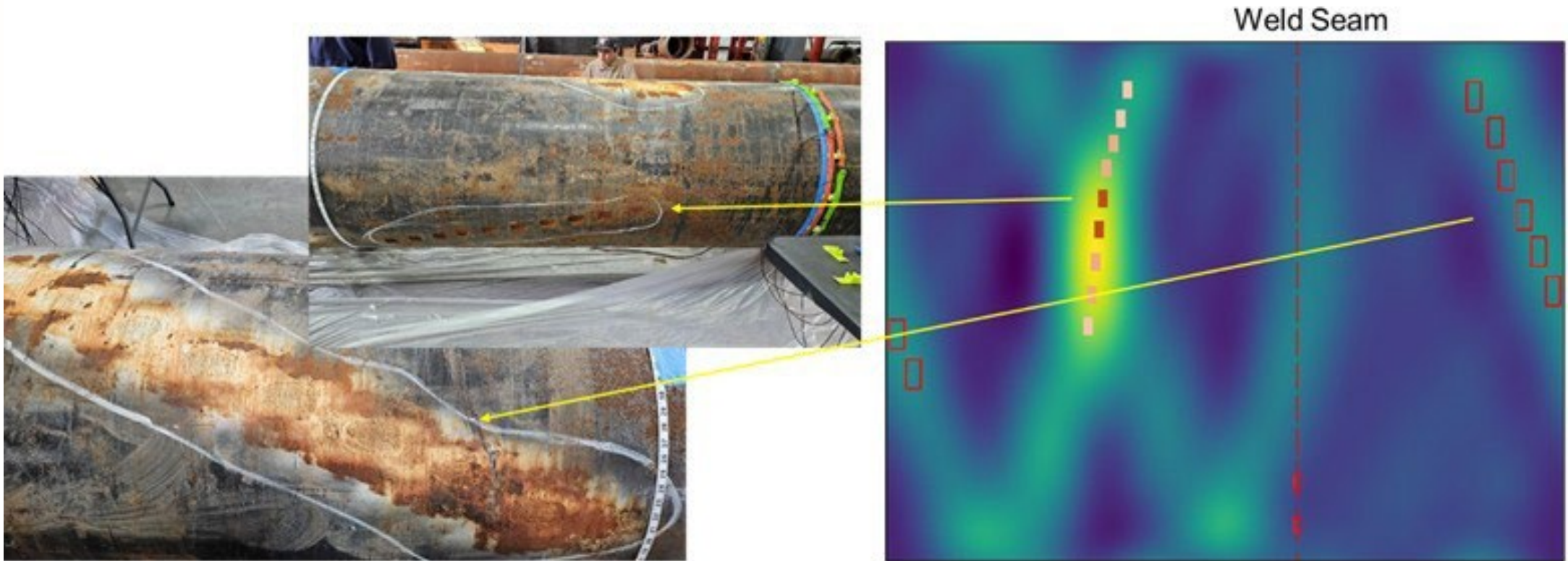
► NATURAL GAS SCRUBBER



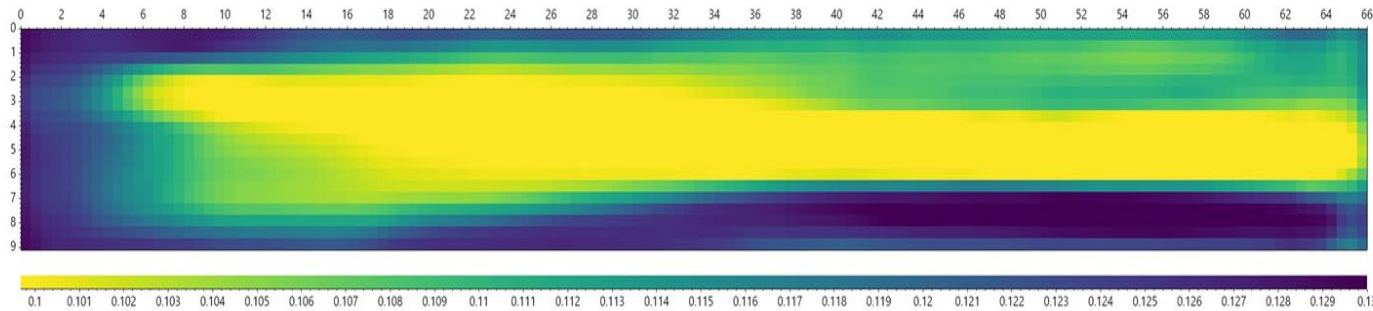
► BURIED LAB PIPE WITH MANUFACTURED FLAW



► LARGE DIAMETER PIPE WITH MANUFACTURED FLAWS

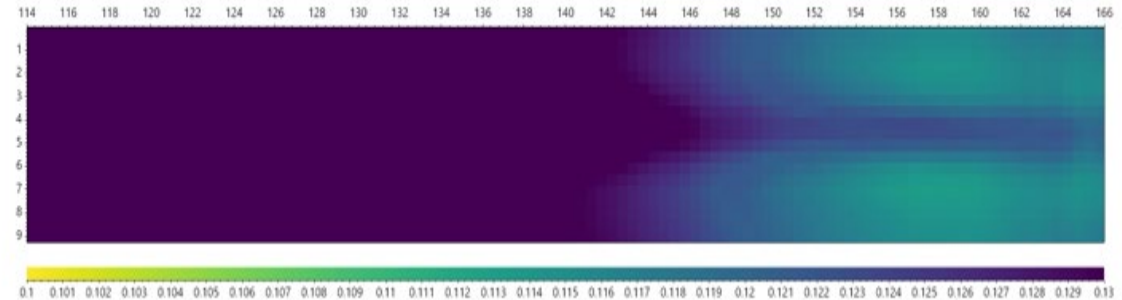


► SHIPBOARD COPPER NICKLE



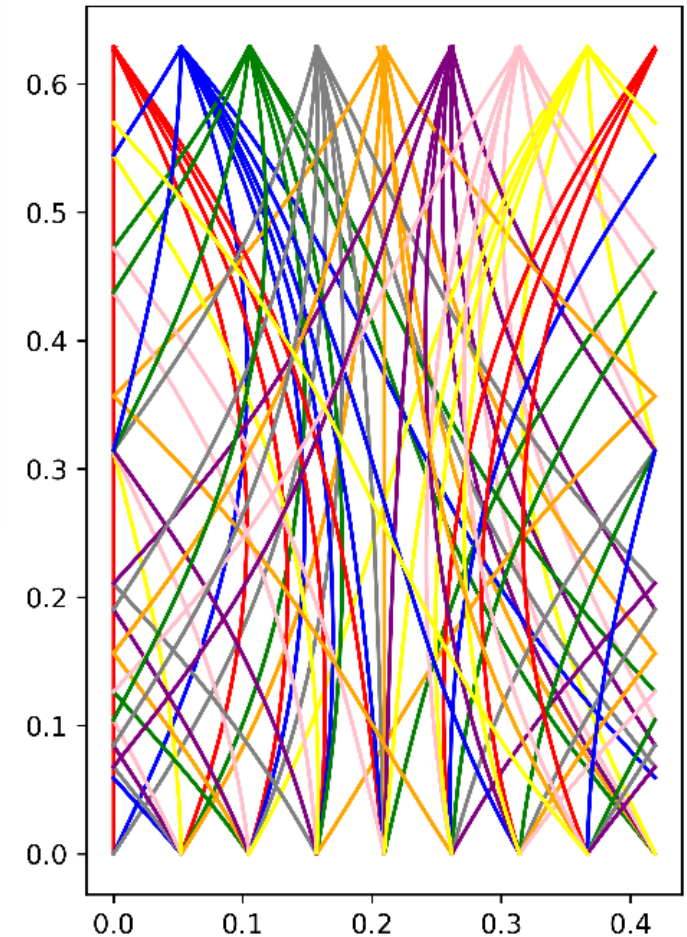
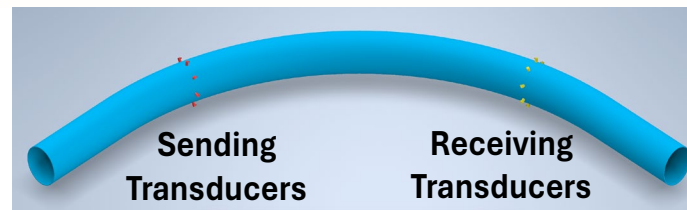
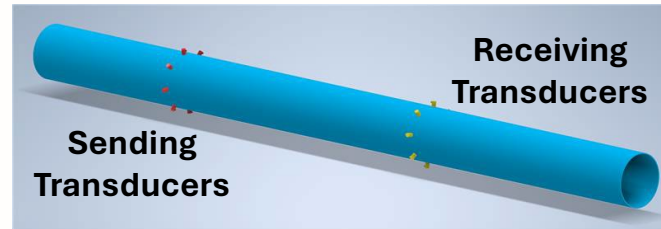
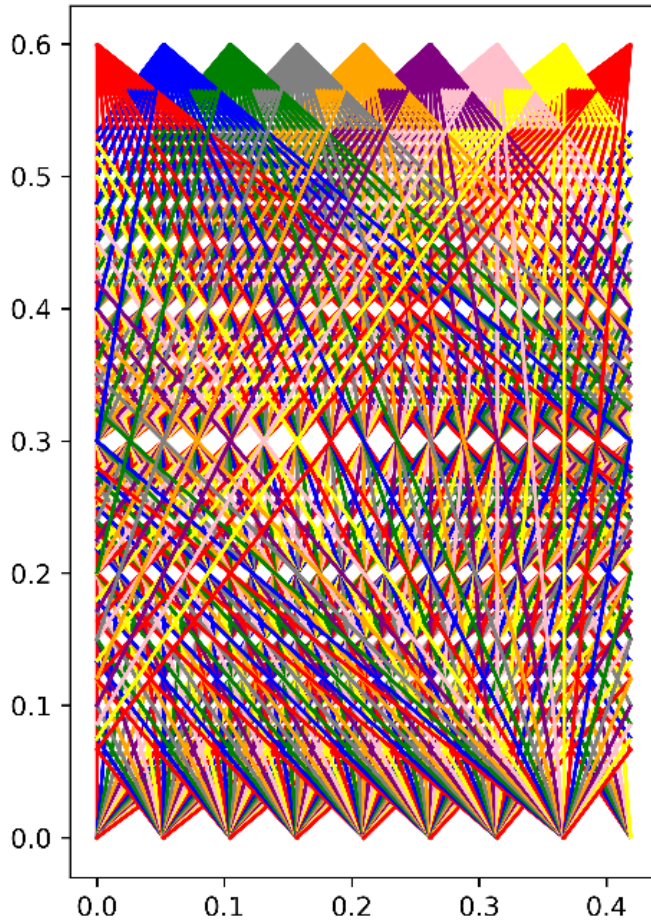
Old Corroded Pipe

Two sections of same pipe
With multiple 2in Rubber hangers



Recently Replaced Pipe

► ELBOW PATHS VS STRAIGHT PIPES

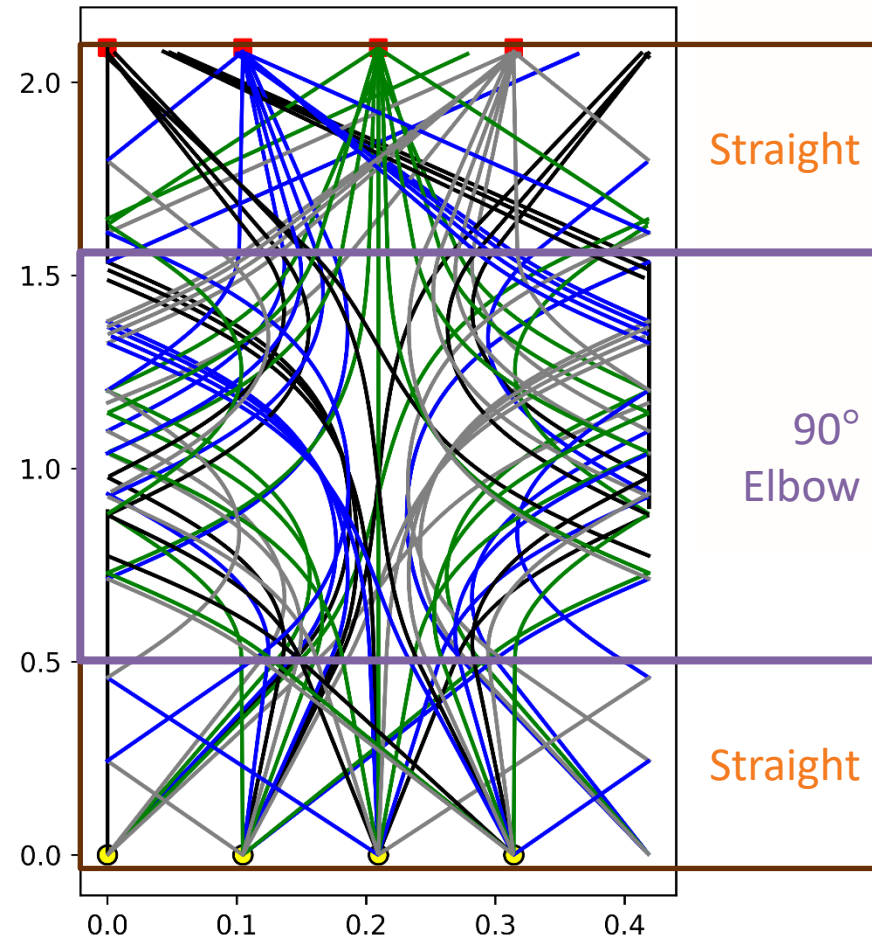


▶ NON-ANALYTICALLY SOLVABLE SYSTEM OF PARTIAL DIFFERENTIAL EQUATIONS

$$\begin{aligned}\dot{\varphi}_1 &= \varphi_2 \\ \dot{\varphi}_2 &= -\frac{1}{r} \sin(\varphi_1)(R + r \cos(\varphi_1))\varphi_4^2 \\ \dot{\varphi}_3 &= \varphi_4 \\ \dot{\varphi}_4 &= \frac{2r \sin(\varphi_1)}{R + r \cos(\varphi_1)} \varphi_2 \varphi_4,\end{aligned}$$

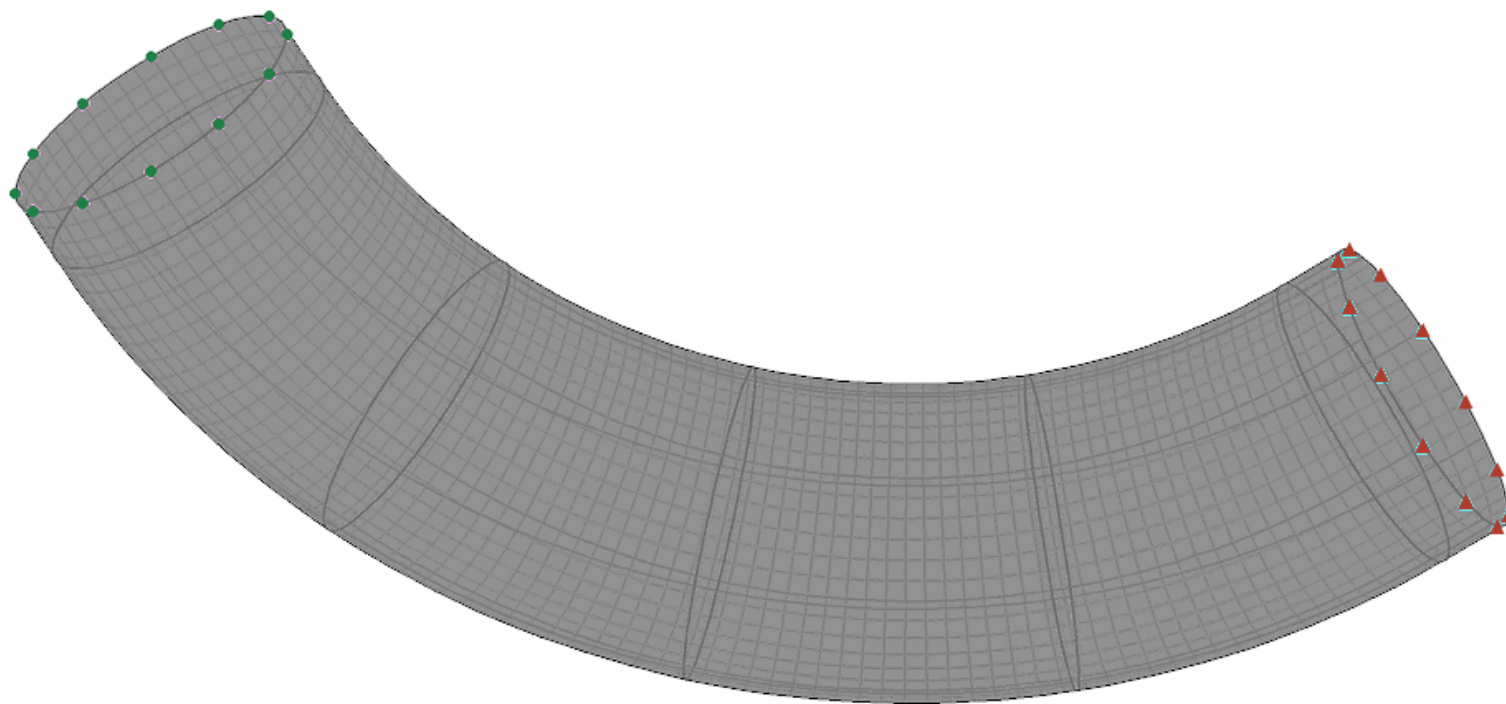
with $\varphi_1 = u$, $\varphi_2 = \dot{u}$, $\varphi_3 = v$, $\varphi_4 = \dot{v}$.

► STANDARD CONFIGURATION OF STRAIGHT AND ELBOW PIPES



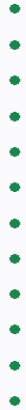
► FIRST ARRIVAL SIMULATION IN SMALL PIPE BEND

Pipe radius = 2.265 in | Bend radius = 12.000 in

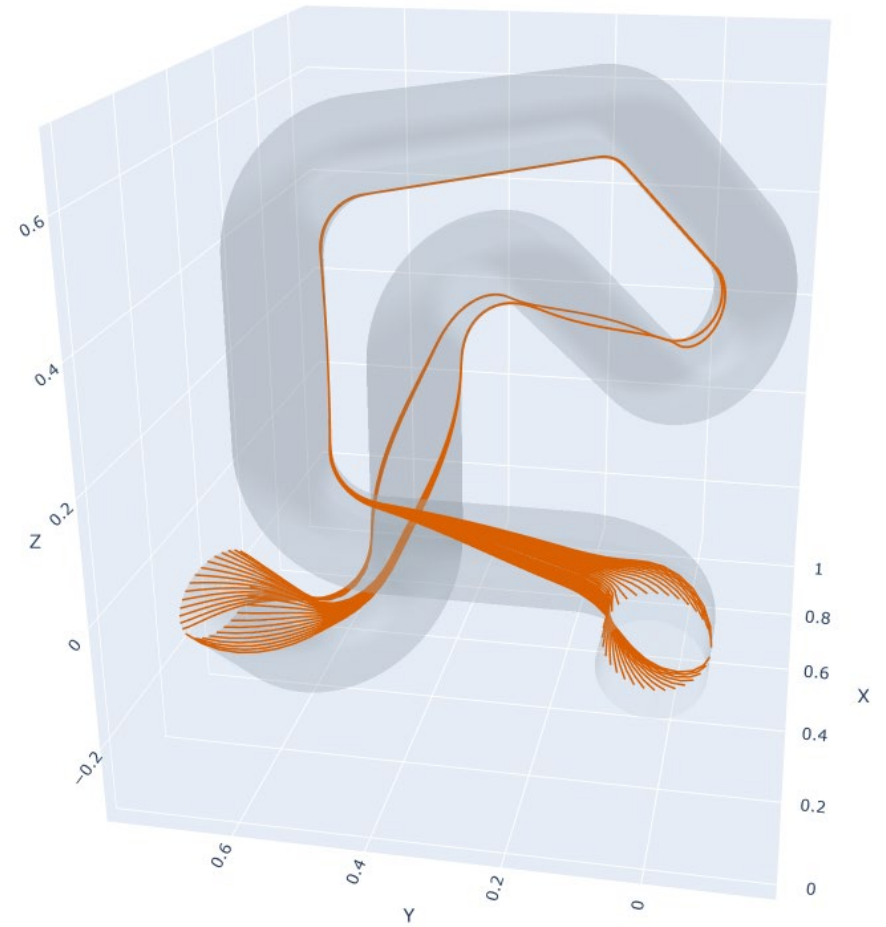
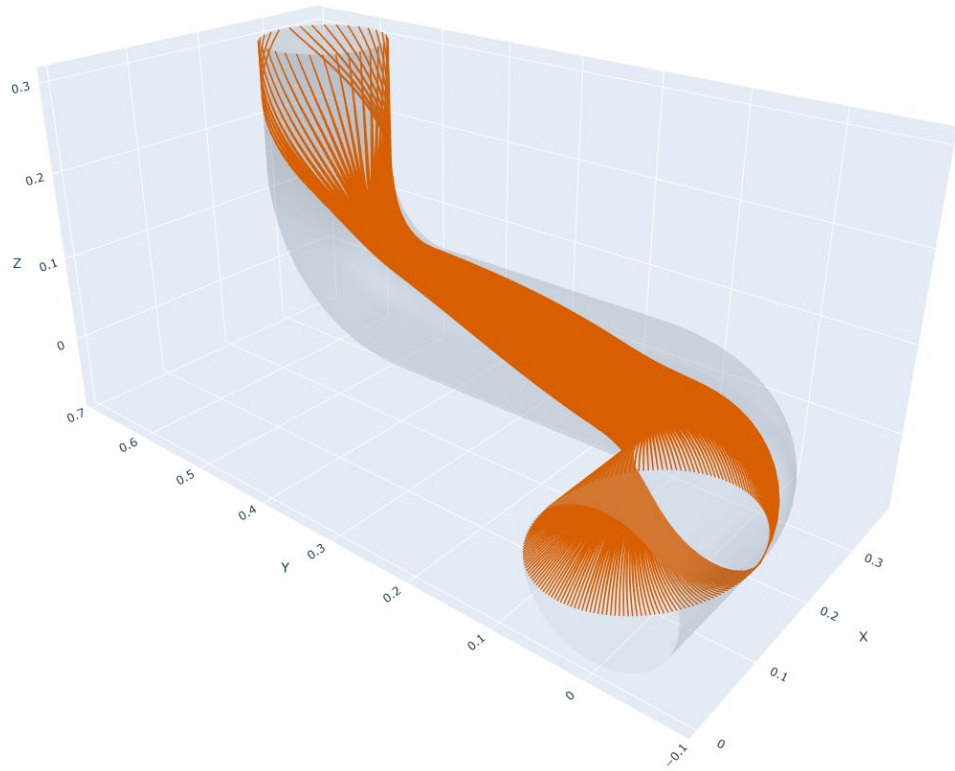


► FLATTENED SIMULATION

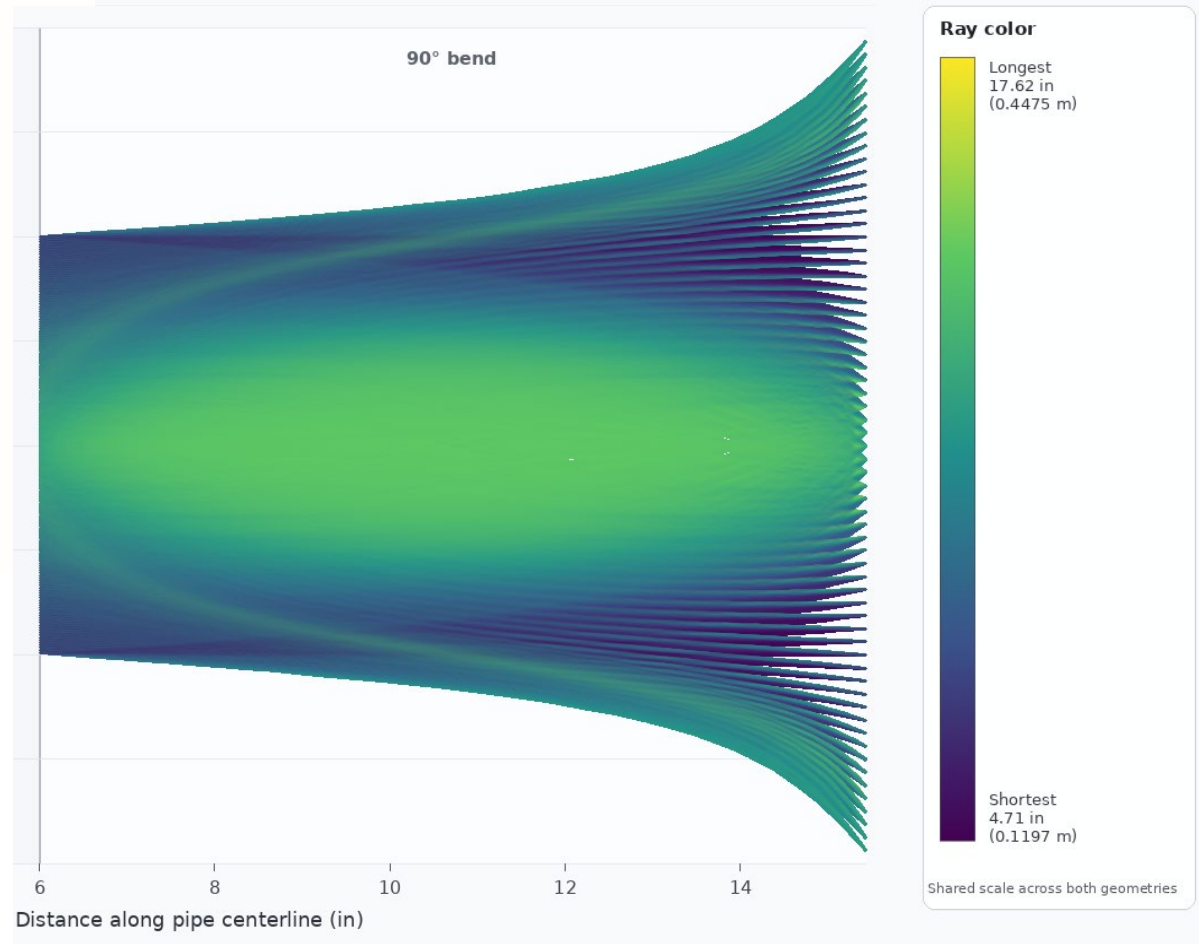
- ▣ All are traveling at same speed
- ▣ Difference in time is from different distance of travel



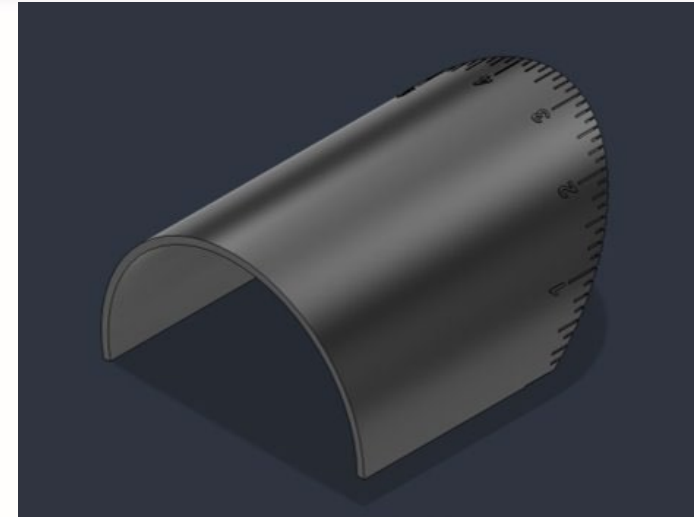
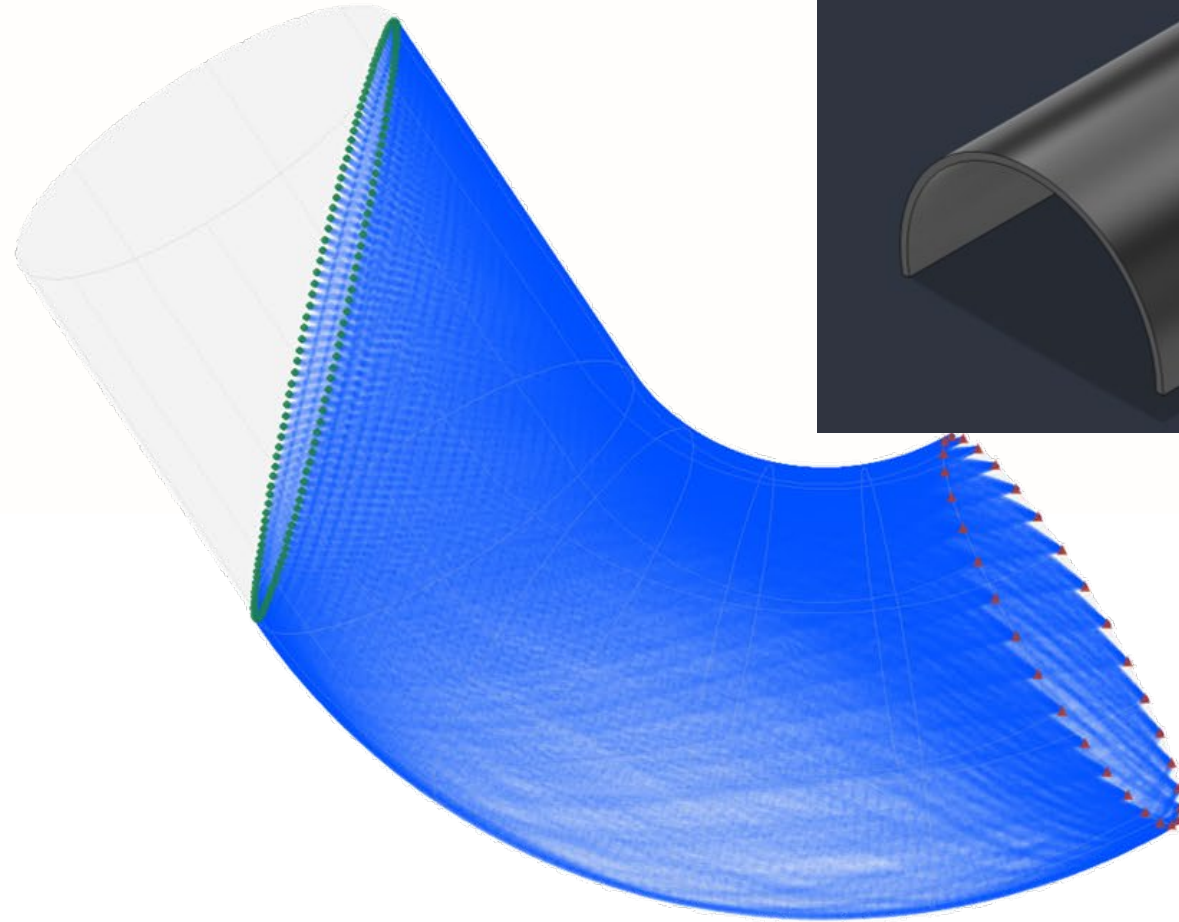
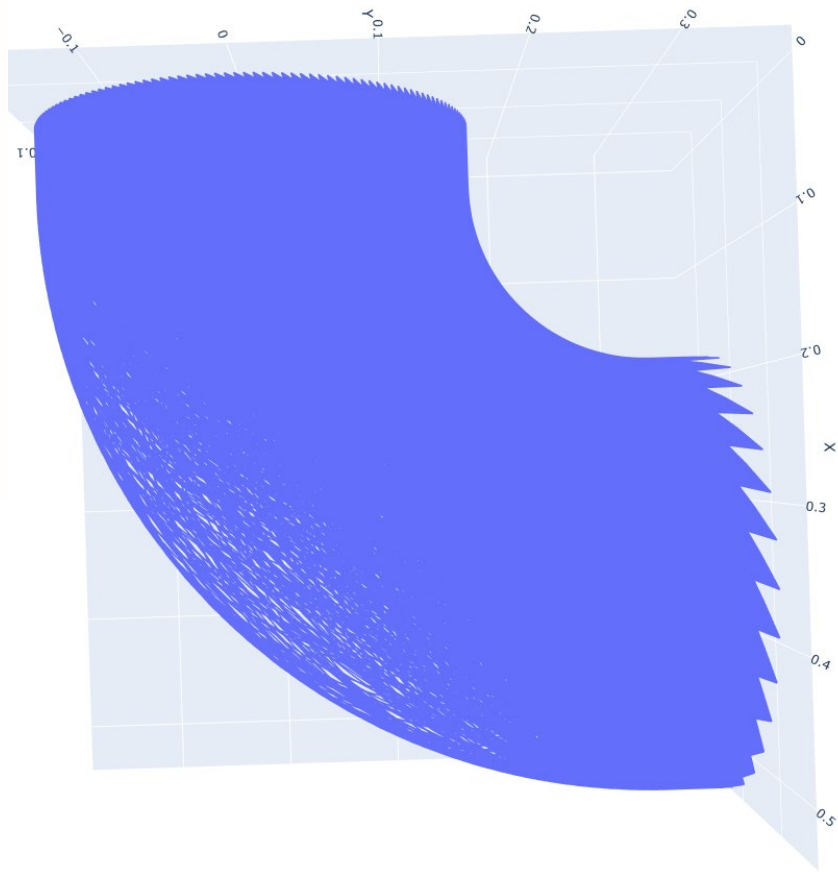
► AS AN ASIDE

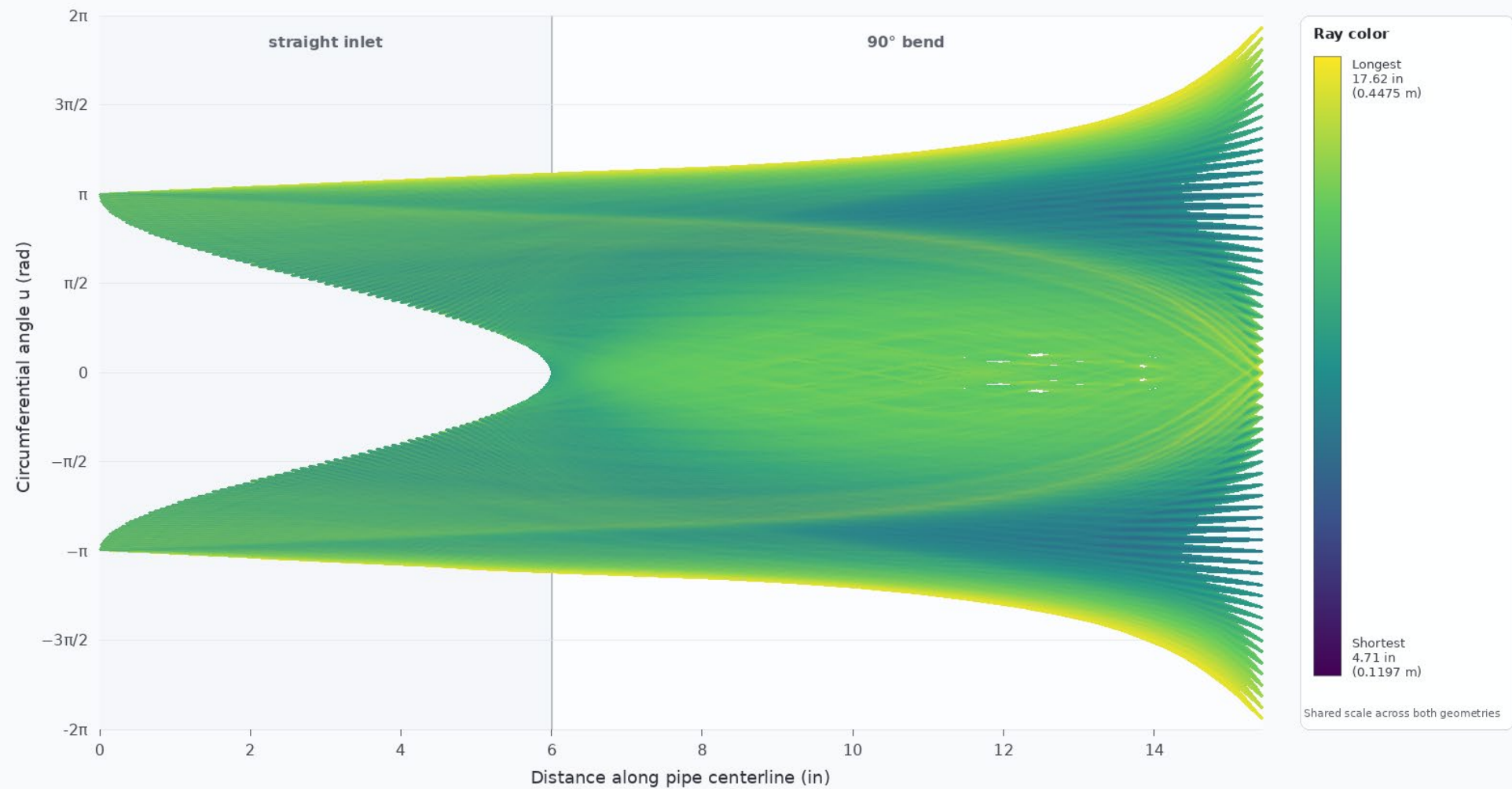


► COVERAGE MAP WITH BEAM LENGTH

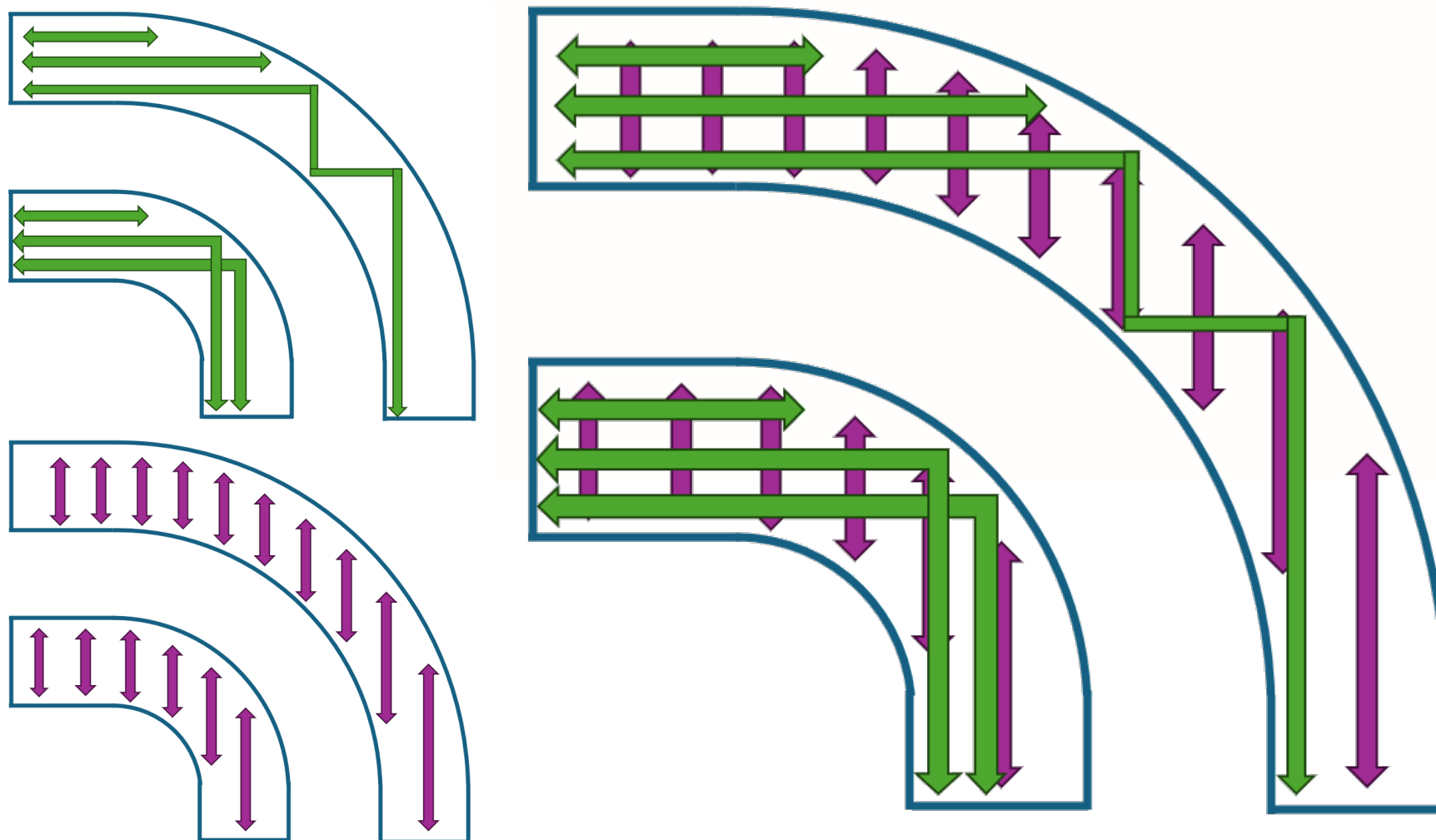


► ANGLED SOURCES



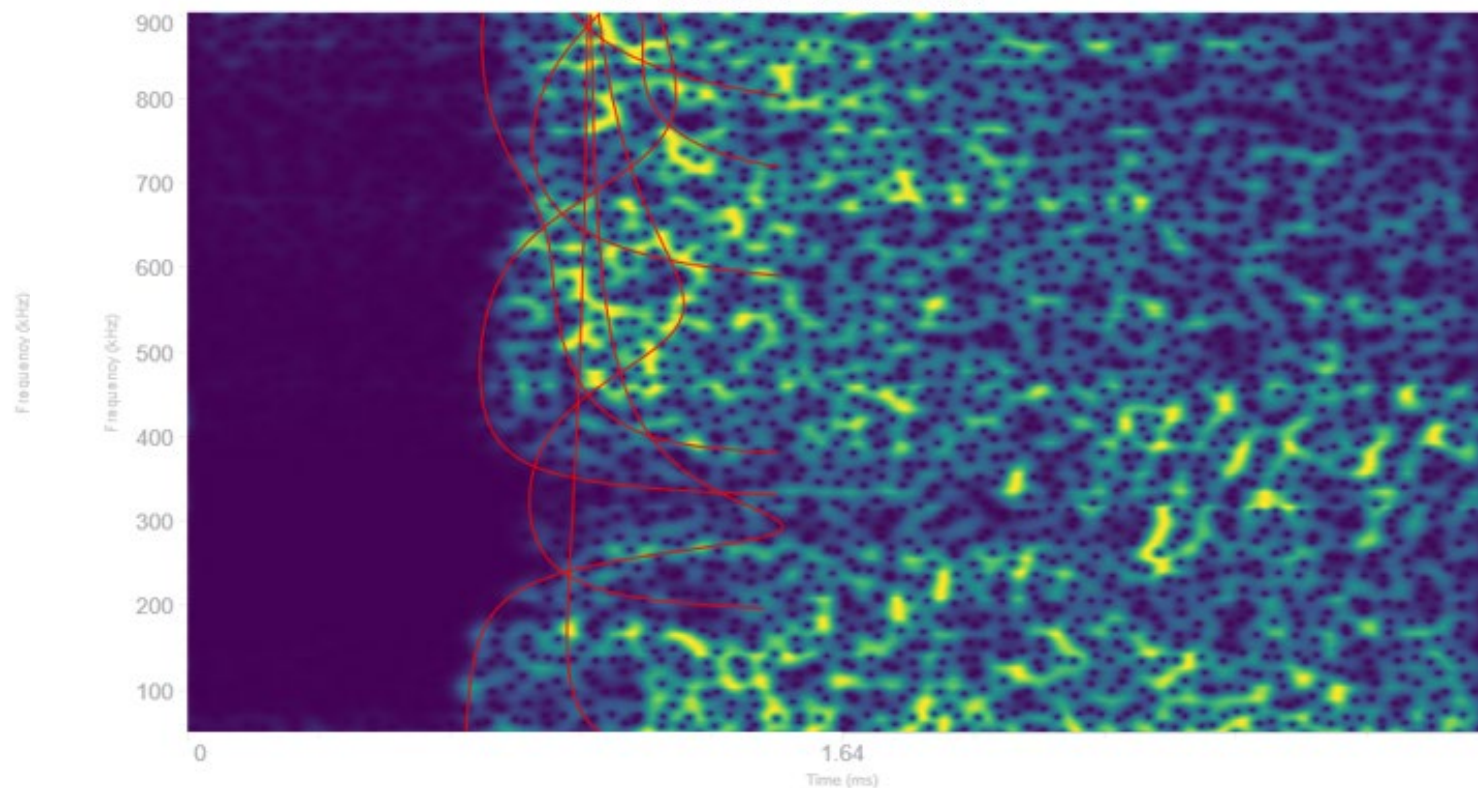


► MODE SHIFTS FURTHER COMPLICATE



► LAMB MODES AROUND ELBOW

**24 Inches
Past Elbow**

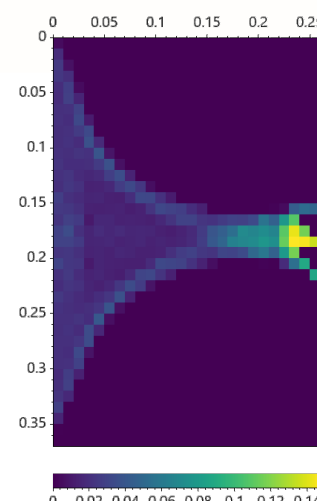
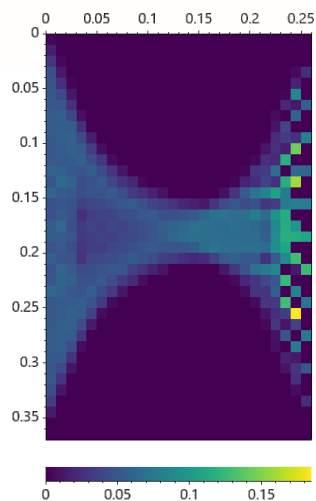
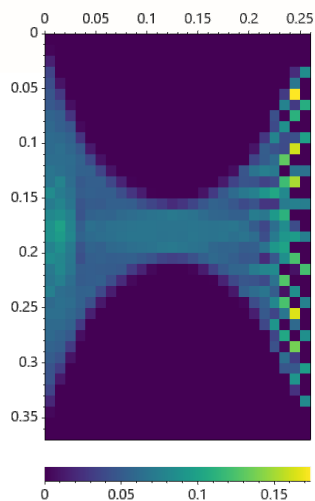
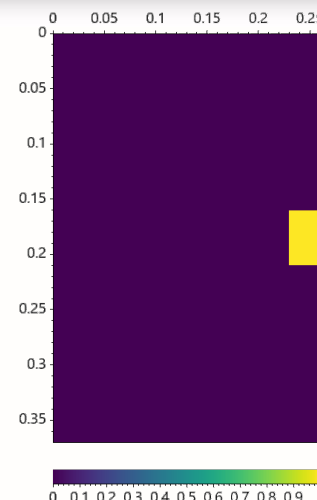
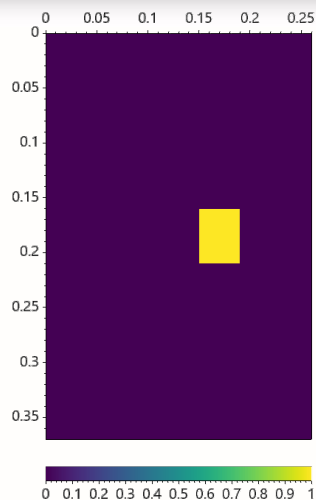
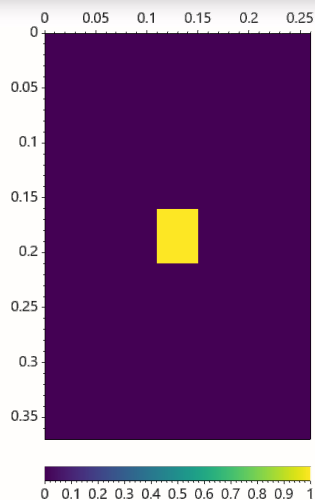


► GENERATING SYNTHETIC SCANS

Projector Input



Reconstruction



← Outer Bend Region

← Inner Bend Region

← Outer Bend Region

► LAB TEST SETUP



► FIELD TEST AT ABOVE GROUND STORAGE TANK FACILITY



▶ THANK YOU, QUESTIONS?

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