EPRI - Ultrasonic Probe Transducer Encoding Device

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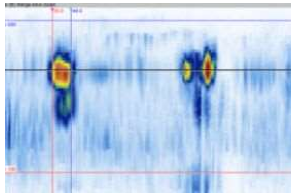
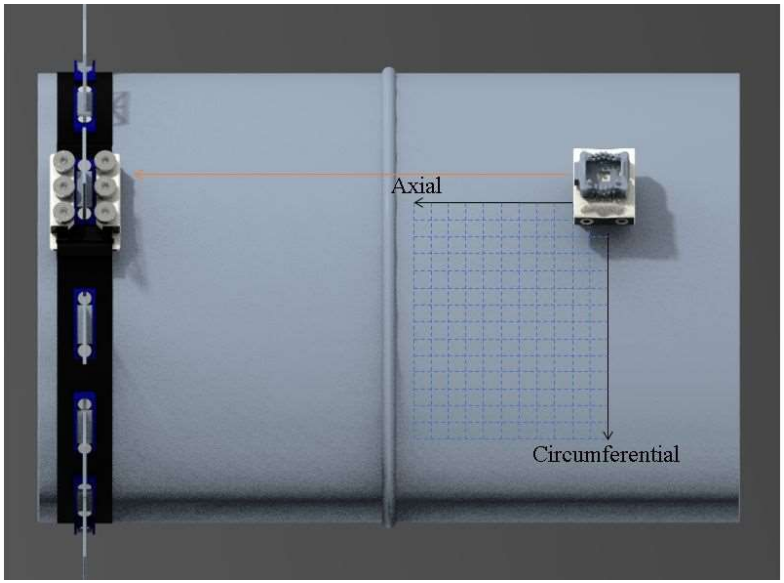
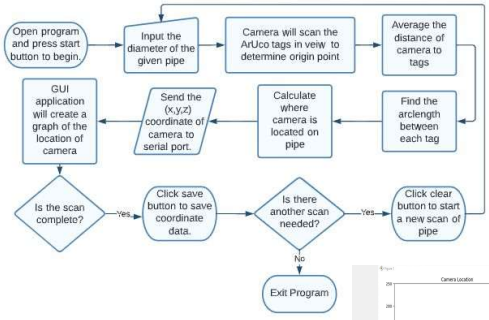
Objectives

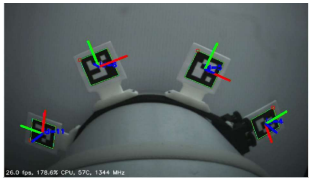
Non-destructive evaluations (NDE) of pipes in industrial settings allow the plant to remain operational while the evaluation takes place. One implementation of NDE is ultrasonic scanning. There is currently no method of accurately recording UT probe positional data for later examination. The EPRI Ultrasonic team must develop a handheld system which can track the positional data of an ultrasonic probe and displaying that data in real time.

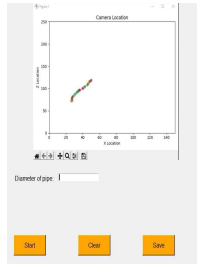




Operational Algorithm







Requirements

- Trainable in under 30 min with a setup time under 10min
- Capable of encoding the position of the UT device an axial distance of 200mm to 1mm accuracy
- Capable of encoding UT position around the circumference of pipes with a diameter of 18 - 915mm to 1mm accuracy
- Able to save the encoded area to a file on a computer in quadrature encoder format
- Utilize a Graphical User Interface
- Interfaces with UT probes in a quick and easy manner, easy to operate
- Capable of collecting data at a linear movement speed of 50mm/sec.

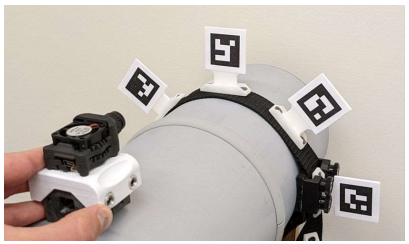
Mechanical Subsystem

ArUco Tags and Belt Design

- ArUco tags are fiducial markers capable of being read by a camera.
- The camera can locate the centers of each tag and output a relative position.
- The belt system displays these tags around the pipe for complete axial and circumferential tracking.
- The belt features magnetic connections and thumb screws for frictionless assembly.

Camera-Probe Interface

- The probe is fixtured to the camera via an interfacing component called the “cap”.
- Two caps are in use, one for circumferential measurements and one for axial.
- This creates a static offset between the focal point of the camera and the reference point on the probe.



System Performance

- Encoding accuracy
  - Horizontal distance (axial distance)
    - 1.07mm-1.19mm error
  - Vertical distance (circumferential distance)
    - 1.42mm-2.62mm error
- JeVois A33 min and max reading distances
  - Min distance: 33mm from ArUco tags
  - Max distance: 283mm from ArUco tags
- Belt tag system pipe diameter range
  - 76mm (3’) to 304mm (12’) (diameter)

JeVois A33 Smart Camera with Axial Cap and UT Probe

Budget

SCAN ME

Utilized Budget: $1,550 of $3,000

References

Motion Sensor Unit for Encoded Ultrasonic Data Collection. EPRI, Palo Alto, CA: 2020. 3002018477.