NSRP | National Shipbuilding Research Program

NSRP Welding Technology Panel Project Proposals

September 2, 2026

Agenda

Title	Speaker
Real-Time Weld Defect Detection	Sophia Millar, Sonibel Instruments
Investigate Larger Diameter (5/32 in.) SMAW Electrode for High Strength, High Toughness Base Materials	Sarah Siddiqui, General Dynamics Electric Boat
Vendor Training Code Clinics Phase 2 Proposal	Lynn Showalter, HII-NNS
AMACS: Adaptive Multi-Axis Control System	Rocky Francis, Automated Technologies International
Cobotic Laser Cleaning with Closed-Loop Control for Repeatable Surface Preparation	David Stone, UDRI
Semi-Auto Stud Welding – Phase 2	Jonathan McDougall, Nelson Stud Welding
WATCH: Walking Autonomous Teammate for Circuit navigation and Hot-work monitoring	Jared Li, IHMC
AI Training Cell for Weld Process Learning	Ryan Gneiting, EWI
FABRIC – Flexible Adapting Build for Reconfigurable Industrial Cells	Duval Corral, GENEDGE
Mobile Robotic Sensing & Path Generation	Bishal Siwal, Georgia Southern University

Sonibel Instruments

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Sonibel Instruments

In-Situ Acoustic Weld Monitoring for Improved First-Pass Yield

September 2026

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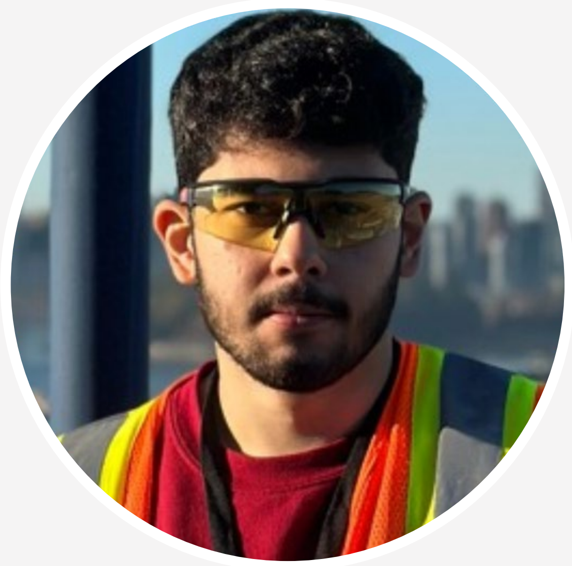
Founders

Sophia Millar

Finance

George Hollo

Manufacturing Engineer



Hooman Pirouz

Mechatronics Engineer

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Sonibel Instruments Background

Pilot deployments with the Royal Canadian Navy and two major US fabricators

TRL 7 → 8

Based in San Francisco

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Weld Rework is a Core Bottleneck

Welding → Volumetric Inspection → Rework → Re-Inspection

3x Repair Time

10x Repair Cost

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Metrics Affected

Reduced First-Pass Yield

Increased consumption of craft and inspection labor

Constrained Production Throughput

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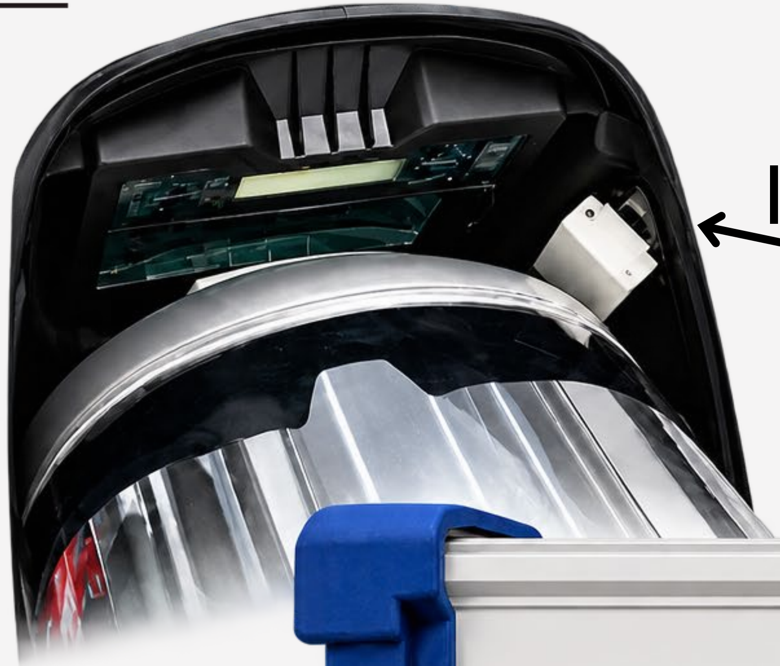

Immediate Alert LED

Acoustic Sensor

Post-Weld Display Screen

sophia@sonibelinstruments.com

Solution: **Pre-NDT** Quality Gate

Sonibel's system alerts welders of defects as they form so welders can complete all rework before NDT. Especially valuable for multi-pass welds

Benefits:

- Increased first-pass yield
- Reduced rework and re-inspection cycles
- Reduced schedule impacts and unplanned work
- **Improved production throughput**

System Strengths

Unique specialized microphone: only at Sonibel

System rated to IK08 and IP 65

Torch mounted rated to IK 09

Retrofits in 20 minutes

No change to weld process

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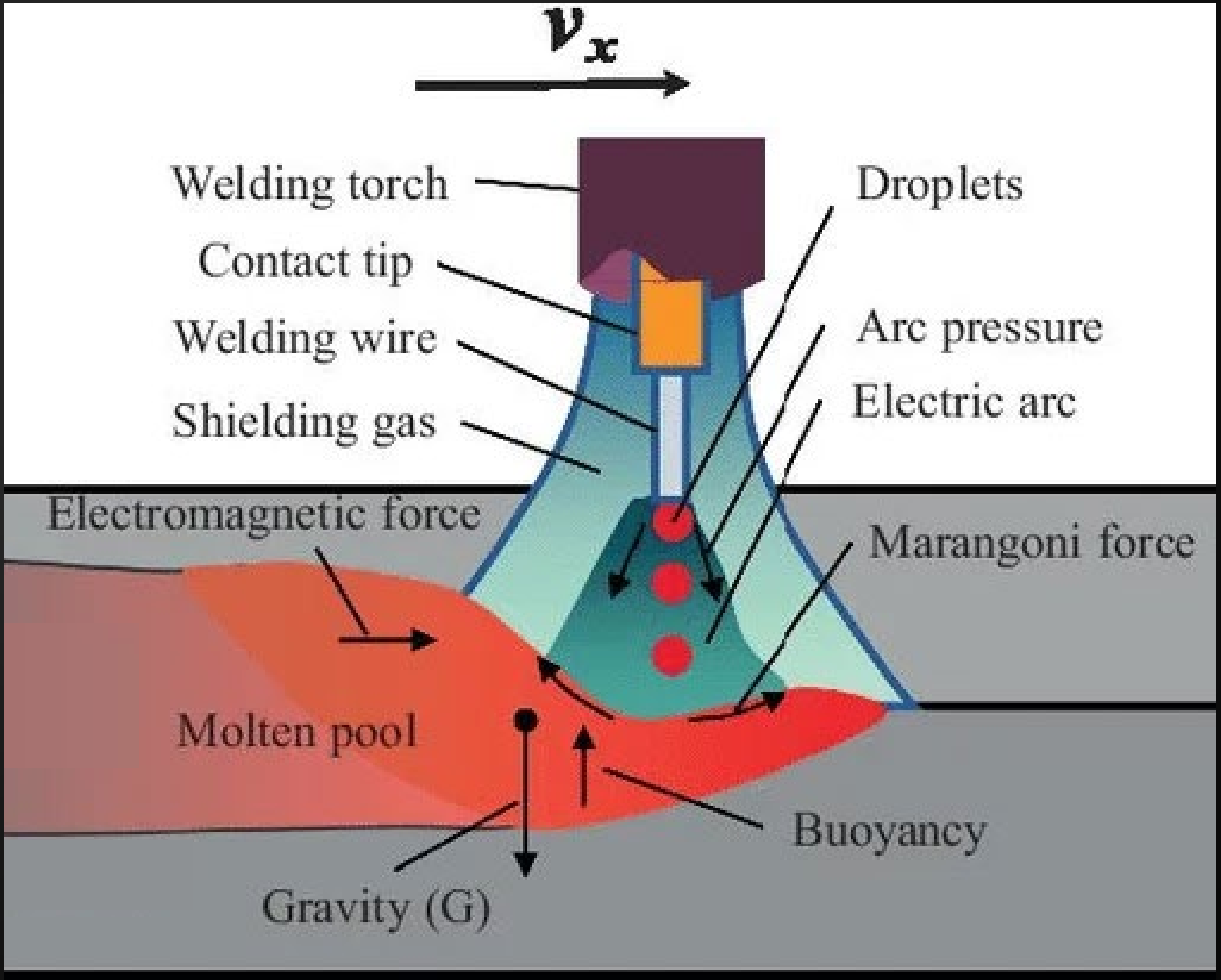
Acoustic Sensor

sophia@sonibelinstruments.com

Acoustic Signals

Defects are associated with changes in:

- Arc stability
- Ignition and extinction behavior
- Droplet detachment
- Droplet impact



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AI (Machine Learning)

Sonibel analyzes the acoustic interaction between the arc and weld puddle during welding

Detects porosity, incomplete penetration, lack of fusion, and slag inclusions

Porosity sound byte

Good weld sound byte

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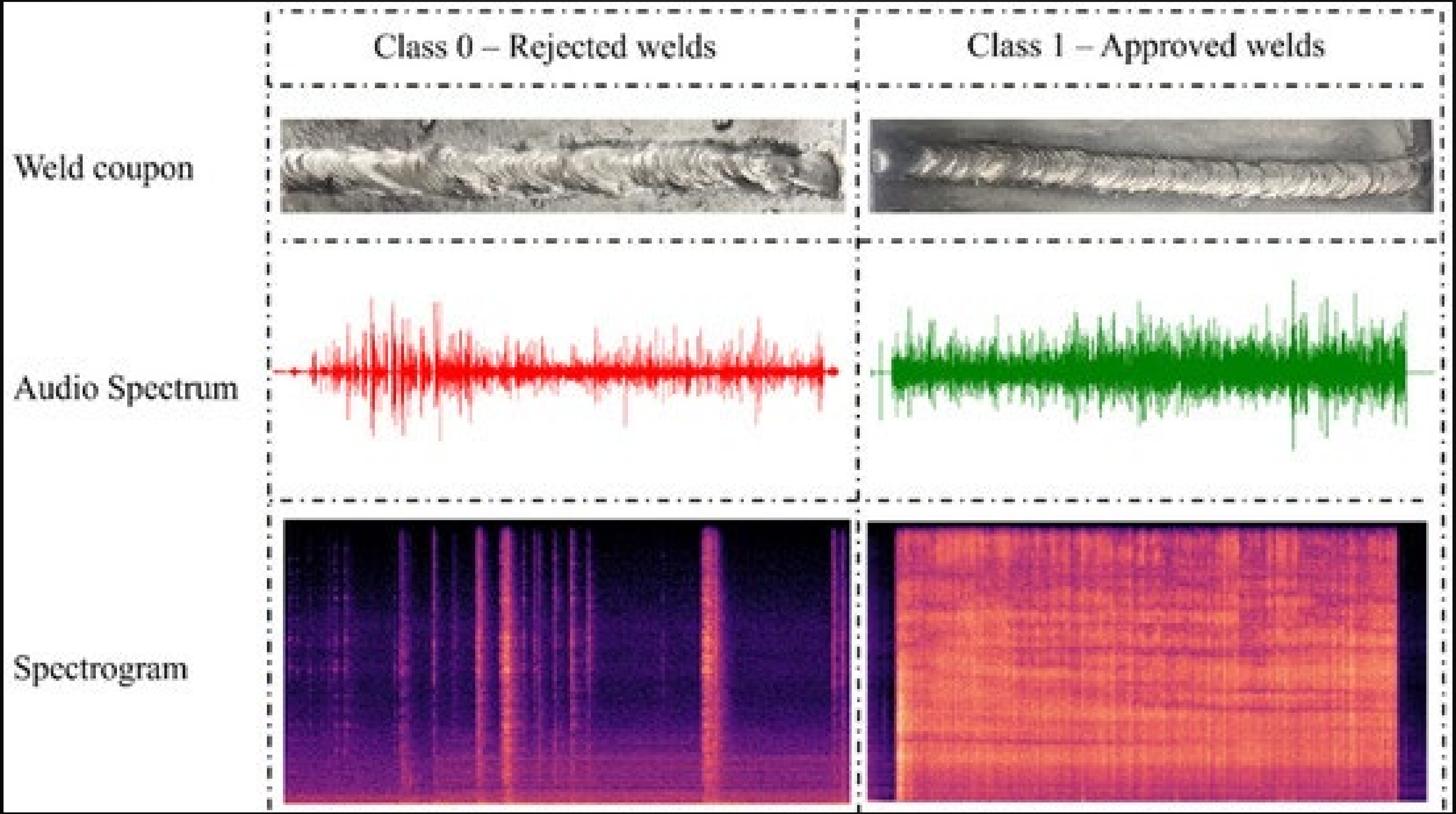
AI Calibration Method

1. Choose a WPS (weld procedure specification)
2. Sonibel records ~60,000 inches of weld audio: good and defect simulated welds
3. Convert audio signals into STFT spectrograms
4. Train Sonibel's AI (machine learning) models on that WPS

Spectrogram-based inputs outperform raw audio-spectrum inputs


Class 0 – Rejected welds
Class 1 – Approved welds
Weld coupon
Audio Spectrum
Spectrogram

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External Lab Validation

Detecting under penetration and burn-through in robotic pulsed GTAW:
96% accuracy

Zhang et al. 2018

Detecting lack of fusion and porosity in SMAW:
95% accuracy

García Rodríguez et al. 2026

Detecting penetration states in CMT/GMAW:
98.8% accuracy

Zhang et al. 2018

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Sonibel Field Validation

Pilot deployments include:

- Royal Canadian Navy: semi-automatic FCAW
- [Undisclosed] major US fabricator: semi-automatic FCAW
- [Undisclosed] US bridge fabricator: SAW

Sonibel’s current models achieve <96% accuracy

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Cost Savings Example

ROI and validity reports from ongoing pilots are in progress

96% → 99.2% first-pass yield	> $300,000/year value from one 20 unit deployment	< 2 year payback 94% ROI over five years

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Proposed Next Steps with NNS

Thank you to Amanda D’Arcy, NNS Technical POC

1. Choose a WPS: 1 month
2. Calibrate Sonibel’s AI for that WPS: <6 months
3. Evaluate in production and measure impact: <3 months
4. Document results for technology transfer: throughout

10 month total project duration

Sonibel Instruments

Sophia Millar
Co-Founder
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NSRP Panel Project Solicitation:

NSRP Panel Project Solicitation:

Investigate Larger Diameter (5/32 in.) SMAW Electrode for High Strength, High Toughness Base Materials

Sarah Siddiqui

General Dynamics Electric Boat
Welding Engineering Advanced Concepts

Contact Information
Email: ssiddiqu@gdeb.com
Phone: (860) 433 3250

September 2026

Proposal

Problem Statement / Concept Description

High strength, high toughness steel base materials are used in naval shipbuilding (including Electric Boat) for critical components. The shielded metal arc welding (SMAW) process is well suited for naval shipbuilding and repair welding since it is versatile for different welding positions and easily portable.

There are many structural welding applications where MIL-10718-M electrodes in smaller sizes are currently used that could benefit with availability of a larger size electrode. Examples of this include but are not limited to joining materials in hard-to-access conditions, upgrading castings, and repair welding a given component. However, there are no available SMAW electrodes that are greater than 1/8 in. in diameter for the MIL-10718-M formulation. This limits deposition rates and increases the amount of electrode changes necessary to complete a given weld or repair.

Project Benefits

The primary beneficiaries include casting suppliers and shipbuilders who are impacted by the cost and schedule risks associated with extensive casting repairs. This work also benefits joining applications where a larger size electrode will improve productivity.

Although the full electrode development is outside the scope of this effort, the immediate benefits are anticipated to increase the TRL of this concept from low (~2-3) to medium (~4-5).

This project addresses a critical manufacturing gap in shipbuilding by enabling the future development of SMAW electrodes that improve productivity in joining steel and depositing repair welds.

Project Goals and Objectives

Lay the groundwork towards developing a 5/32 in. diameter MIL-10718-M electrode.

1. Compile background and information from legacy tasks.
2. Perform weldability/operability evaluations using various sizes of similar SMAW electrodes to better define limits on welding positions and joint types.
3. Define the minimum manufacturing and/or performance requirements that must be met for a larger diameter MIL-10718-M SMAW electrode.
4. Engage with electrode manufacturers, including traveling to sites to discuss need, technical aims, and logistics. Obtain quotes from suppliers to develop and manufacture a larger diameter MIL-10718-M candidate SMAW electrode.

Technology transfer and implementation approach:

Upon project completion, based on the results and findings, the team will pursue additional developmental work to procure and test the selected electrodes targeted for shipbuilding applications and advance technology readiness levels (TRL).

Previous and Current Related Work

Previous Work:

3/32 in. and 1/8 in. diameter MIL-10718-M electrodes have been successfully developed, qualified, and used in naval construction for several decades.

Current Related Work:

NSWCCD has recently produced and tested developmental 5/32 in. diameter SMAW electrode. However, this consumable was not found to be shipyard viable since it was not expected to robustly produce weld metal meeting performance requirements in the vertical welding position.

Method, Deliverables, and Timeline

Objective	Action	Deliverable	Timeline
Compile background and information from legacy tasks	Gather details on previous relevant work tasked by different funding sources and compile a brief comparison between legacy specifications (PPD 802-6337513) and current specifications (NAVSEA TP/0200).	Summary report	Quarter 1
Perform weldability / operability evaluations	Perform weldability evaluations using various sizes of SMAW electrode to better understand the operability of existing, smaller diameter electrodes as compared to similar or same classes of available 5/32 in. diameter electrodes (which may include developmental electrodes, electrodes certified for non-ballistic applications, or both).	Summary report	Quarter 1
Define requirements for developmental electrode procurement	Baseline the minimum manufacturing, fabricating and/or performance requirement(s) that must be targeted by an electrode manufacturer.	Statement of work	Quarter 1 – 2
Engage with electrode manufacturers	Travel to candidate electrode manufacturers to discuss need, technical aims, and logistics, and identify the tolerances and limitations that can be specified in an RFP and supporting technical documents. Using this information, obtain quotes for industrial suppliers to manufacture a 5/32 in. diameter SMAW electrode that meets the requirements of MIL-10718 electrode in accordance NAVSEA TP/0200 and any additional requirements as informed by the results of this task.	Submit cost quote requisition with supporting technical documents	Quarter 2 – 4
Task Completion	Assemble final project package	End of project report, quotes received from electrode manufacturers, and compilation of deliverables	Quarter 4

Vendor Training Code Clinics Phase 2 Proposal

:

Lynn Showalter - HII-NNS
Welding Engineer 5
Associate Technical Fellow

Presented to:

Welding Technology Panel Meeting
:

AMET, Inc. 355 Dividend Dr.

Rexburg, ID

September 1 & 2, 2026

NSRP Project Phase 2 Proposal

- What is the opportunity ?
- Phase 1 focused on training needed to develop the PQR’s and the WPS’s
- During our survey with key SME’s (Public Shipyards, Private Shipyards, Consultants and NAVSEA) the following opportunities were identified:

Challenges

- We asked them, what are the most common mistakes discovered during audits at welding vendors?

- Incorrect application of an approved Welding Procedure(s)
  - Not aligned with Fabrication Document
  - Unapproved weld joints
  - Unqualified Positions

Challenges (vendor mistakes)

- Using commercial/AWS filler metal that is advertised as ***capable of*** meeting Mil-Spec, but is not ordered with MIL Spec testing
- Failure to accomplish SMAW moisture testing
- Filler Metal chemical overchecks are missing
- Application of procedure and parameters beyond intended limits
  - Appropriate amps & volts for the electrode size, material thickness or welding position
- Knowing how to apply and measure preheat/interpass
- Using hand held torch preheat when not appropriate or permitted
- How to measure and verify heat input

Challenges (vendor mistakes)

- Non-compliant handling and storage of filler metal (co-mingling with other types of MIL-SPEC or commercial filler metal, not keeping clean)
- Welder qualification issues (workmanship, vision tests, quarterly maintenance, positions or thickness)
- Welding equipment not appropriate, equivalent or in good working order
- Shielding gas flow meter and gas mixture change issues
- Not performing monitoring/surveillance of welders
- Using subcontract welding without flowing down all PO requirements
- Not getting approval to transfer welding procedures to another site of the activity.

Challenges (vendor mistakes)

- Improper cleaning prior to welding and not interbead cleaning and inspecting.
- Included angle on production weld joint, tighter than qualification permits
- Improper application of Post Weld Soaks versus Post Weld Heat Treatment
- Production Welding Records –nonexistent or missing key data

Project Plan _reminder

- Vendors in over 40 states for the various Private and Public Shipyards.
- The vendors need guidance in developing those **production and quality procedures** in addition to qualifying PQR's and WPS.
- Weak to little or no welding SME's onsite.
- This project is focused on the following NAVSEA specifications
  - **Tech Pub 278**
  - Tech Pub 248
  - Tech Pub 271
  - MIL-STD-22D
  - MIL-STD-1628
  - MIL-STD-2035

NSRP Project Phase 2 Proposal

- Jeremy Buller – Electric Boat (EB)
- Richard Arn – AWS and his Staff
- Lynn Showalter – Newport News Shipbuilding (NNS) –Lead
- Kevin Roossinck – Ingalls Shipbuilding
- Public Yard support for Phase 1 and possible for Phase 2
  - John Cullen – PNSY,
  - Kyle Ellison -NNSY,
  - Kevin Gormont – PHNSY
  - Ben McCreary – PSNS

AWS Project Panel

AWS Panel Team

Name	Professional Role	Employer	Experience
Ben Arn	Consulting Weld Engineer	Industry/ Corporation/FB M	11-20 years
Dr. Richard Campbell	Welding Consultant	Non-profit/ Retired Bechtel	21+ years
Blake Craft	Welding Consultant	Non-profit	21+ years
Michael Fronk	Mechanical Engineer/Weld Engineer	Government/ Military/NAVSEA	11-20 years
Richard Holdren	Principal Welding Engineer	Industry/ Corporation/ ARC spec.	21+ years
Lee Kvidahl	Welding Engineer	Retired- Ingalls Shipbuilding	21+ years
Larry Mullins	Director/Engineer	Self	21+ years
Nancy Porter	Project Manager	Retired - EWI	21+ years
Lynn Showalter	Welding Engineer 5 Associate Technical Fellow	Industry/ Corporation/NNS	41 + years

AWS Staff

Staff Member	Job Title
Richard Arn	Vice President, Welding and Technology
Yangling Zhang	Managing Director, Certification
Kyle Payne	Director of Assessment
Blake Craft	AWS Trainer

- AWS will support Phase 2 in the same manner

Project Plan – Review Phase 1 & Phase 2

- Training is being developed with AWS to be delivered to the target audience through their training program.
- AWS has an AI internal training development tool which is be utilized.
- Online Meetings conducted with key AWS Team Members
- Meetings with the AWS Project Panel
    - Texas Tech DFW February 26th and 27th (JTA Developed)
    - Breakout meetings with AWS and Project Team Leadership
- Presented Project to Public Yards CoP Meeting In San Diego August 11-12th
- Same Approach for Phase 2

Project Plan –

- As presented above, the vendors need guidance in writing the required quality procedures to support their welding operations and how these procedures are connected and reference each other.

    - That is why Phase 2 is proposed to cover training beyond PQR and WPS

- Questions ?

Automated Technologies International

SIEMENS DEVELOPMENT PARTNER

FLORIDA

St. Petersburg • Southeast

WASHINGTON

Seattle • Pacific Northwest

MISSION

Connect measured reality to advanced engineering and automation

Making complex industrial work more accurate, adaptable and repeatable.

Automated Technologies International

CEREC: From the first commercial chairside dental CAD/CAM system in 1987 From the first commercial chairside dental CAD/CAM system in 1987 to today's integrated scanning, design, milling, and finishing work flow.

MRT

Early **image-guided therapy or surgical navigation** at Brigham and Women’s Hospital: registering medical instruments spatially inside the physician’s working area and relating their live position to MR images.

Dr. Ferenc Jolesz From Brigham faculty in 1985 and began combining MRI, three-dimensional visualization, instrument navigation, and surgery. Harvard’s history describes his work as the convergence of surgery and imaging and credits his group with developing new visualization and navigation techniques. Harvard Medical School memorial history

Four decades at the digital–physical interface

Early medical 3D scanning

Large-scale Alberta field measurement

High-precision 3D support for the H.L. Hunley

The recurring problem: make measured reality usable, persistent and recoverable.

AMACS

ADAPTIVE MULTI-AXIS CONTROL SYSTEM

Persistent Spatial Control Infrastructure

Strengthening proven welding, robotic and metrology technologies

Automated Technologies International

The AMACS Anchor Provides Persistent Spatial Control

Mobile equipment can move quickly. Its trusted relationship to the ship cannot.

MOVE

Rail, robot, scanner and process equipment relocate

REBUILD

Measurement, setup, safety zones and program confidence are re-established

REPEAT

The same overhead returns at every large or changing work zone

The automation cell is temporary. The ship is the enduring artifact.

AUTOMATED TECHNOLOGIES INTERNATIONAL

The equipment can move.
The control relationship persists.

Reacquire the rail and robot against references already tied to the ship—then validate and continue.

AMACS keeps identity, geometry and process state tied to the artifact

ANCHOR

Persistent reference tied to ship or workpiece

→

MOBILE DELIVERY

SmartTrack, rover or AMR registered to the work

→

GATEWAY

Transforms, device identity, state and authorization

→

PROCESS

Proven scanning, welding, grinding and inspection

AMACS does not replace the robot, scanner, welding source or engineering system.

It makes their relationship to the ship persistent, recoverable and usable across deployments.

One repeatable sequence carries control through the entire work package

CREATE CONTROL → EXTEND CONTROL → PERFORM THE WORK → VERIFY • UPDATE CONTINUE

A controlled move becomes a continuation—not a completely new cell.

We call it… Spatial Total-Scene Continuity - STC

AMACS ShipWelder

Anchor.
Register. Lock. Work.

The rail and robot reacquire against Anchors tied to the ship.

SET ALIGN LOCK

WORK • VERIFY • UPDATE • CONTINUE

AUTOMATED TECHNOLOGIES INTERNATIONAL

Welding technology controls the process. AMACS preserves its relationship to the ship.

PROVEN WELDING SYSTEMS

Power source
Torch and consumables
Weld procedure
Process monitoring

→

AMACS ENVIRONMENT

Artifact reference
Deployment state
Coordinate continuity
Move and reacquisition

Designed to support AMET, Civan Lasers and other qualified technologies—not replace them.

AMACS Shipbuilder with AMR

Navigate.
Lift. Lock. Work.

LiDAR + Wi-Fi navigate.
AMACS locks the AMR into the Digital Scene.

WORK • VERIFY • UPDATE • CONTINUE

AMACS ShipWelder inside a persistent, recoverable spatial enviornment. Scan, weld, and verify.

AUTOMATED TECHNOLOGIES INTERNATIONAL

One bounded demonstration proves persistence through a controlled move

1	REGISTER	Install persistent references on a representative structure
2	DEPLOY	Register rail, rover or AMR, robot and metrology
3	PERFORM	Scan and complete one selected welding or preparation task
4	RELOCATE	Move the platform to a second work zone
5	RESUME	Reacquire, validate and continue without rebuilding the cell

One possible Phase 1 test: shop-to-ship module alignment and weld

1. **SHOP ARCHIVE** — Set Anchors; survey two modules with a tracker and scan with our dense scanning instrument
2. **REACQUIRE** — Reacquire both modules at the shipyard in the same Anchor-defined coordinates
3. **ALIGN 6DOF** — Guide X/Y/Z, roll, pitch and yaw; remeasure the fit-up and lock the fixture
4. **HAND OFF** — Freeze the verified transform and pass the approved work zone to the welding system
5. **WELD + VERIFY** — Weld, inspect and update the as-built archive against NASSCO acceptance criteria

Proposed targets—finalized with the participating shipyard

RELOCATION CONTINUITY

10 consecutive cycles within the task-defined spatial acceptance band

CHANGEOVER EFFICIENCY

≥25% lower median setup or requalification labor/time than baseline

VALIDATION DISCIPLINE

All injected stale-reference, wrong-tool and configuration mismatches detected before continuation

TRACEABLE RECORD

Every task and verification record tied to its authorized location, configuration and revision

Persistent control turns mobility into productive continuity

LESS RESET

Reduce repeated setup and re-establishment after equipment moves

MORE UTILIZATION

Keep high-value robots, scanners and welding equipment working across zones

TRACEABLE STATE

Preserve measured geometry, process results and configuration history

VENDOR CHOICE

Integrate proven commercial technologies without locking the platform to one supplier

THE REQUEST

One shipyard. One bounded task. One trusted result.

- NASSCO shapes the task, baseline and acceptance criteria
- **12 months • Pilot Program**
- Down-select the submitted bounded demonstration

Create Control → Extend Control → Perform the Work → Verify • Update • Continue

Cobotic Laser Cleaning with Closed-Loop Focus Control for Repeatable Surface Preparation

PROJECT INFORMATION

Prime/Lead: University of Dayton Research Institute (UDRI)
David Stone: *David.stone@udri.udayton.edu*
Team Members: Newport News Shipbuilding (NNS): *James Brooks NNS*

Problem: During laser Cleaning **Technicians must maintain laser standoff** (focus) within a **tight ±4 mm** window, otherwise **risk inconsistent ablation** and **excess heat input** to the part with no objective process record.

Solution: **Using UDRI's laser and robotic integration expertise** this project **automates laser standoff control** by mounting a production-representative laser end-effector on a collaborative robot by integrating distance sensors and pyrometer-based thermal limits into generated robotic path plans to improve cleaning quality and generating per-article data

OBJECTIVE

Make laser surface preparation faster, more consistent, and far less dependent on operator skill.

- Hold laser consistently within its focal window during processing on representative shipyard geometries for consistent material cleaning
- Reduce variability in HAZ depth, producing a predictable and specifiable result rather than an operator-dependent one.
- Generate logged process data sufficient to support future qualification of laser ablation

DELIVERABLES/BENEFITS/ROI

Deliverable:

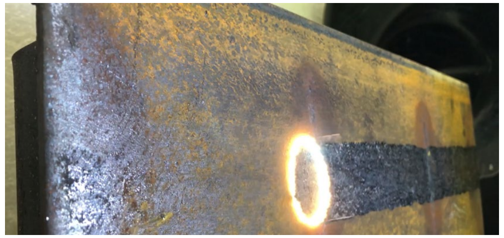
1. **Cobotic laser cleaning cell** with Closed loop, focus control demonstrated on representative shipyard articles.
2. **Characterization dataset** correlating focus error and surface temperature to cleanliness and HAZ outcomes.

Benefits:

1. **Productivity:** Sustained in-focus processing plus continuous cobot duty cycle raises effective area rate.
2. **Rework avoidance:** Predictable HAZ reduces damage, rejection, and repair of prepared components.
3. **Workforce:** Converts artisan dependent operation into a repeatable process a differently skilled operator can run.

FINANCIAL / SUPPORTING DETAILS

Program Funds: $200K
Duration: 12 months



Representative industrial laser cleaning process: GClaser LLC

UDRI's Robotic Composite Laser Surface Prep (RoboCLASP)

In Phase two of this project, Nelson Stud Welding plans to do the following.

1. Take their 900B battery powered stud welder and further develop its software so that it can create better user experience for Auto-Feed Stud Welding.

2. Finalize Design and produce production intent refillable cartridges able to hold 100 studs. Final cartridge to be durable that will allow cartridges to be refilled at Newport News and other shipyards. Provide a way to distinguish between different stud lengths.

3. Make prototype cartridge feeder into production intent cartridge feeder. Resolve challenge in Phase 1 that will allow cartridge feeder to be run off battery power from the 900B.

4. Finalize Design and produce production intent– Auto Feed Stud Gun. Which will include addressing weight concerns with improved cable management and potential cover tube modifications. Add cover for stud gun receiver to address conductivity concerns. Re-orient feed tube for better ergonomics and sight of stud location, particularly for overhead (4S) and both left and right-handed users. Make final key (which changes between 7/8" and 1 7/8" long studs out of durable material and label key to easily identify which length you have selected… Address gun lift board challenges in Phase 1.

5. Finalize Design and be able to demonstrate Cartridge Feeding Station, that would allow Newport News and other shipyards to refill cartridges at their facilities.

WATCH

Walking **A**utonomous **T**eammate for **C**ircuit navigation and **H**ot-work monitoring

Jared Li – Research Scientist – IHMC

Erik Bjorkner - Senior Manager, Systems Engineering & Technology - Austal USA

Garry Shields – Director of the Disruptive Technologies Laboratory (DTL) – NAVSEA Carderock

Overview

- Fires often start after the 30-minute fire watch window
- **Proposed Solution:** Roving Spot Quadruped robot to conduct post-fire-watch inspection of hot work sites to prevent larger fires from developing
- TIP Relevance
  - 7.3.2.3.4, Infrastructure, Logistics and Sustainment. 7.2.2.4.3, Ship Production Technologies, the implementation of collaborative robots in manufacturing.

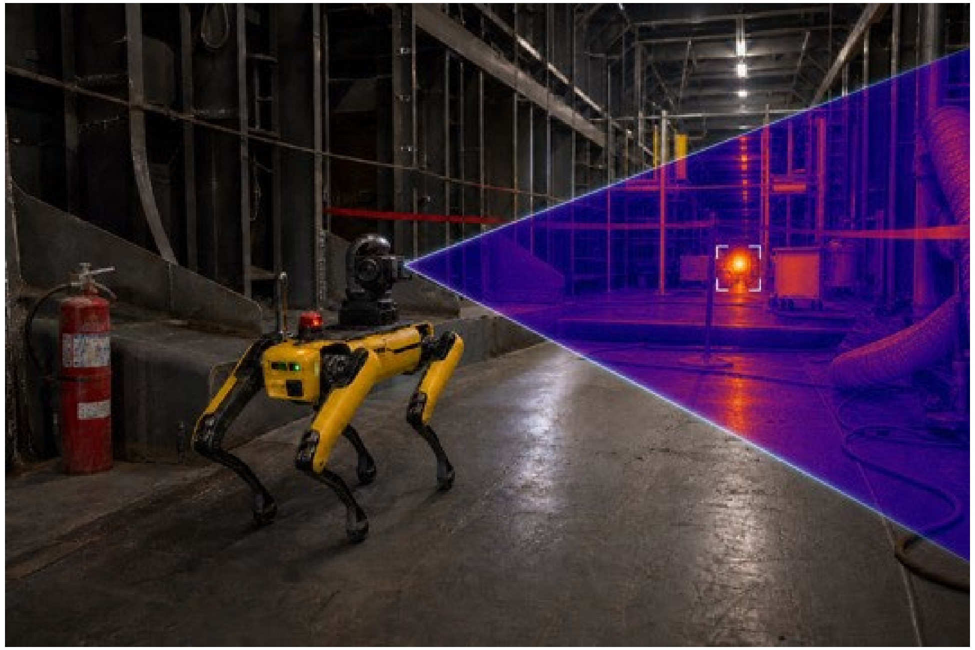
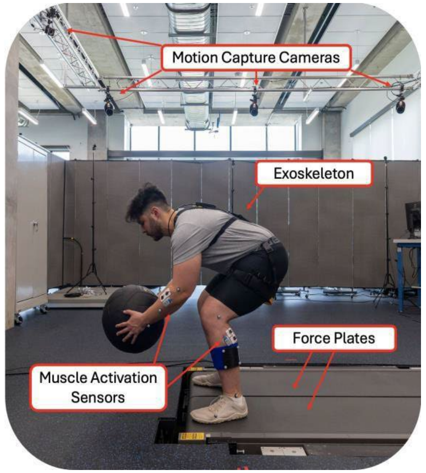


*Image generated using ChatGPT Sol 5.6

Relevance to Current Work

- EASE – PP26-35 (ongoing)
  - Explore injury prevention potential of commercial exoskeleton devices
  - Test commercial exoskeletons in shipyard environments
  - Figure out gaps in usefulness, design new device
- How WATCH differs
  - Worker augmentation
  - Autonomous robot acts as extension of worker capability
  - Increased individual and site safety
  - **Improve efficiency of labor hours**



The Boston Dynamics Spot Quadruped

- Core to all 3 projects
- Field-tested system (TRL 9)
- Deployed in numerous industries for autonomous inspection tasks
  - Oil and gas
  - Nuclear decommissioning
  - Logistics and warehousing
  - Mining
  - etc.
- Not largely used at shipyards
  - Some research work ongoing
- IHMC owns 2, NSWCCD owns 1

Video of Spot walking around and surveying worksite at Chevron

Quad Chart

PROJECT INFORMATION

Prime/Lead:
Florida Institute for Human and Machine Cognition (IHMC)
(Jared Li)
Team Members:
Austal USA;
NSWC Carderock Division (Government participant)
Duration:
12 months

OBJECTIVE

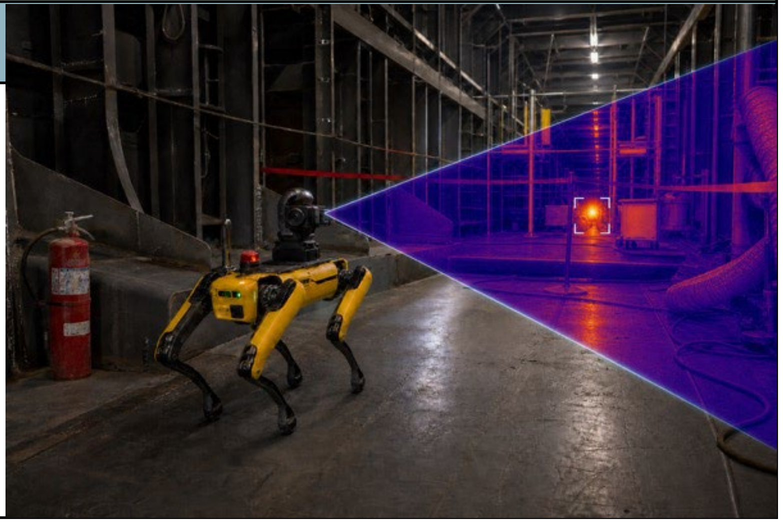
- Extend thermal monitoring of hot-work areas past the 30-minute fire watch into the 2-to-12 hour delayed-ignition window, with no added watch labor.
- Equip an IHMC-owned Boston Dynamics Spot quadruped with a radiometric IR camera and high-visibility strobe to patrol a taught circuit of the day's hot-work sites, comparing each site against its baseline cooling curve.
- Measure detection performance against seeded thermal anomalies and establish how many sites one platform covers per route.

DELIVERABLES/BENEFITS/ROI

- IR and strobe patrol payload with circuit autonomy software, demonstrated on Spot with interface documentation another yard can reproduce.
- Shipyard route map and hot-work circuit procedure that sits alongside the yard's hot-work permit program.
- Early identification of delayed ignition, the window in which catastrophic shipyard fires typically start.
- Measured ROI in the public Final Report.
- Starting TRL 4; projected TRL 6 at completion.
- Spot currently TRL 9 in other industries

FINANCIAL

Program Funds:
$200K
Cost Share:
~$170K in-kind
(IHMC Spot platform)



IHMC's Recent Work

Video of IHMC's recent work of 2 Spot robots working together to complete a task.

WATCH

Walking **A**utonomous **T**eammate for **C**ircuit navigation and **H**ot-work monitoring

Thank you for listening! Questions?

ihmc
FLORIDA INSTITUTE FOR HUMAN & MACHINE COGNITION

AUSTAL
USA
INNOVATIVE ON LAND.
EXCEPTIONAL AT SEA.

NAVSEA
WARFARE CENTERS
Carderock

AI Training Cell for Weld Process Learning

Project Lead Organization: EWI
Project Team Members: Ryan Gneiting and Katie Hardin (EWI), and Amanda D'Arcy (NNS)

Concept/Idea

Issue: Expert welders make continuous process decisions using audio, visual, and other weld feedback cues, but those decisions and cues are not captured. Without synchronized process, motion, and inspection data, it is difficult to train AI/ML models or transfer expert welder knowledge to other welders.

Proposed Solution(s): EWI will develop an AI training cell that captures weld process inputs, motion, and weld quality outputs from expert welders. The result will be cell capable of producing time and position-based weld data sets that enable AI training and model development.

Benefits/Justification

Benefits of the Project: Learning from expert welders will enable higher quality welds for other welders and other applications in the shipyard.

Enables future AI/ML model development.

These models could be used to do in process monitoring during production and provide a feedback to the operator or do adjustments if enabled.

Project Approach

High Level Statement of Work: EWI will define the data structure requirements, develop input and output monitoring hardware, then finalize the data structure for AI training use.

Metric(s) of Success:

- Input/output monitoring hardware developed and integrated
- Data structure defined and finalized for AI training use

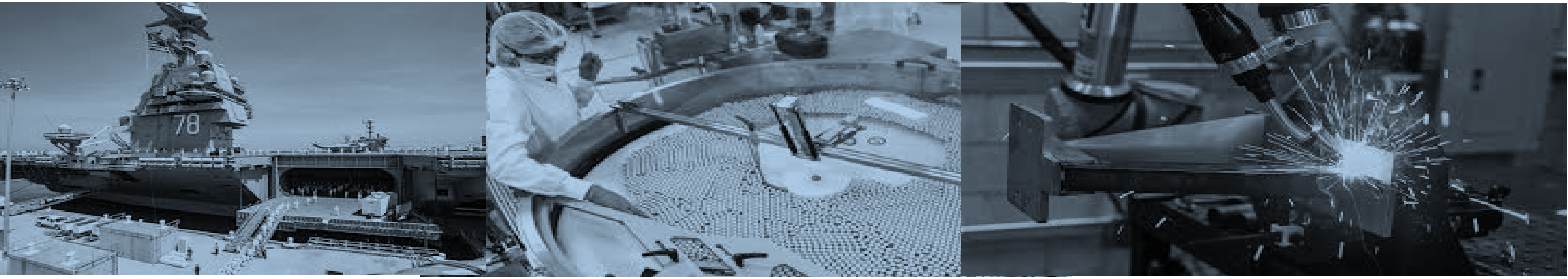
Cost/Images/Relevant Information

Project Estimated

Cost: $200k

EWI has a track record combining real-time process sensing, machine vision, and AI/ML for manufacturing quality.

INNOVATE **COMPETE GROW**



FABRIC – Flexible Adapting Build for Reconfigurable Industrial Cells

Duval Corral, Technical Lead

GENEDGE

GENEDGE PROGRAMS

Agenda

- Problem & Industry Need
- Proposed Solution
- What is ModTruss?
- Panel Focus Areas and Project Benefits
- Deliverables and Program Details

Manual Fixturing Limits Quality and Throughput

Fabrication of small-to-medium welded components at Newport News Shipbuilding (NNS) - including doors and hatches - relies on manual alignment practices such as piano wire and visual fit-up. These craft dependent methods introduce variability in weld fit-up, increased distortion risk, and inconsistent repeatability that directly impacts welding quality and production throughput.

- Manual, craft dependent setup
- Inconsistent weld fit-up and elevated distortion risk
- Time consuming fixture setup and teardown cycles
- Scrap waste generated during teardown

ModTruss Enabled Fixturing For Process Improvement

NNS has agreed to support FABRIC as this project uses ModTruss components to introduce modular, repeatable and reusable fixturing systems to improve weld joint alignment and stability during fabrication.

- Reusable to minimize waste
- Modular to accommodate multiple components
- Repeatable and consistent fit-ups

ModTruss In Entertainment and Aerospace

ModTruss is a modular structural framing system made from reusable, high-strength components that can be bolted together to create custom structures, fixtures, platforms, supports, and frames.

- Modular by design
- Adaptable to any need
- High strength for reliability

Welding Technologies Panel Priority Focus

7.1.2.3	7.2.2.1	7.2.2.8
Identify and implement flexibility, modularity, and scalability across platforms to increase throughput	Develop and implement Manufacturing Processes for construction, fabrication and assembly	Investigate improvements to standardization, commonality and modularity

Tools and Fixtures for Fitting and Welding A Modtruss Enabled modular fixture replacing piano wire and craft dependent methods	**Improve Welding Productivity** Fixture cycle time cut from 72 to 24 hours; set up and alignment time down up to 67%
Improve Welding Quality Improves weld fit-up consistency across repeated builds and multiple components	**Reduce Distortion and Residual Stress** Fixture stability directly targets weld-induced distortion risk
Reduce Rework Targets up to 25% reduction in rework tied to welding defects	**Welder Training for Production** Structured Build & Train and Follow-On Training phases, backed by FABRIC Handbook
Process Limitations and Capabilities Finite element analysis validates stress and load capacity before fielding	**Guidance for Welding Engineering** Engineering-approved configurations formalize repeatable procedures across components

What NNS Receives at Project Close

1

ModTruss Welding Fixture

Complete fixture and all hardware needed to build every engineer-approved modification

2

Fixture Handbook

Instruction manual covering assembly and disassemble for all approved configurations

3

Final Report and Evaluation

Document process impacts, feedback survey results and outcome data

Questions? Comments? Concerns?

Questions? Comments? Concerns?

Duval Corral

Program Manager

dcorral@genedge.org

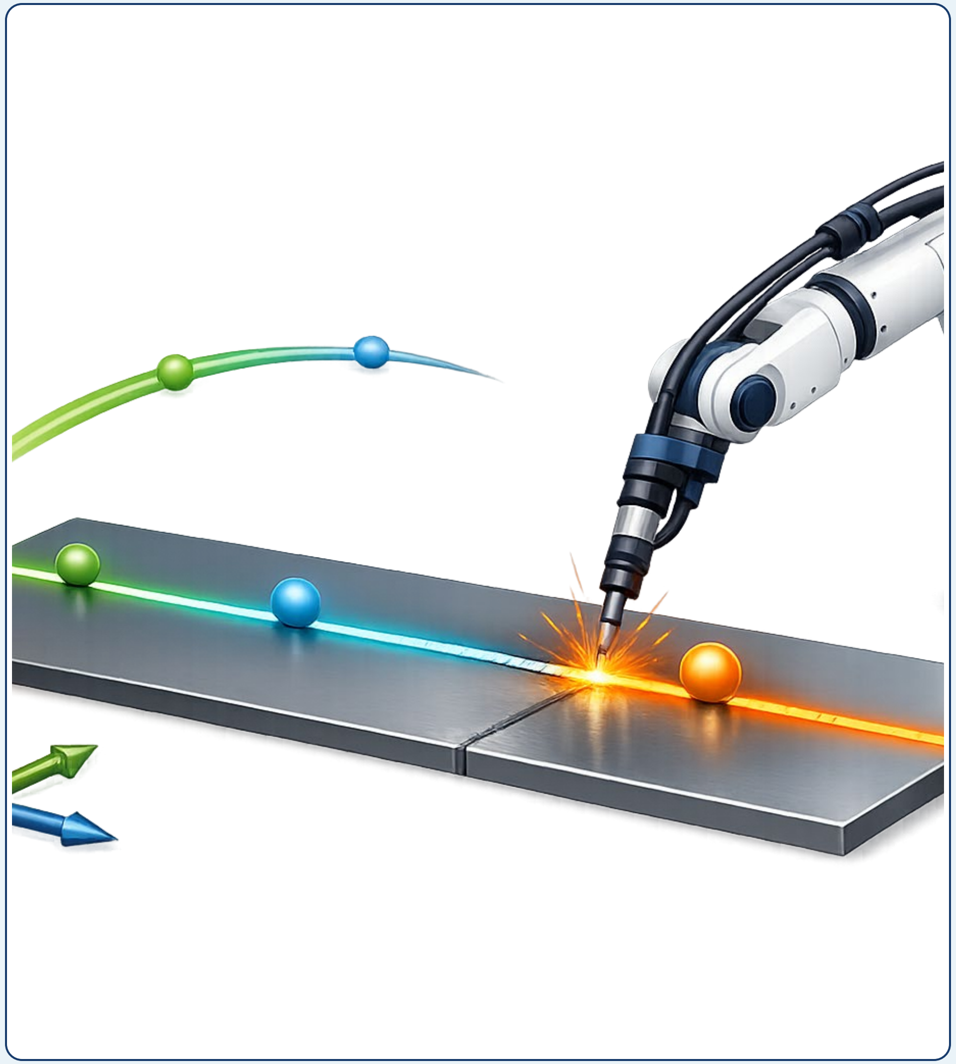
NSRP FY27 PANEL PROJECT

Mobile Robotic Sensing & Path Generation

and Inspection for Shipyard Welding and Crack Repair

Georgia Southern University (Lead)
Newport News Shipbuilding (Support)

Primary: Welding Technology | Secondary: Business Technologies



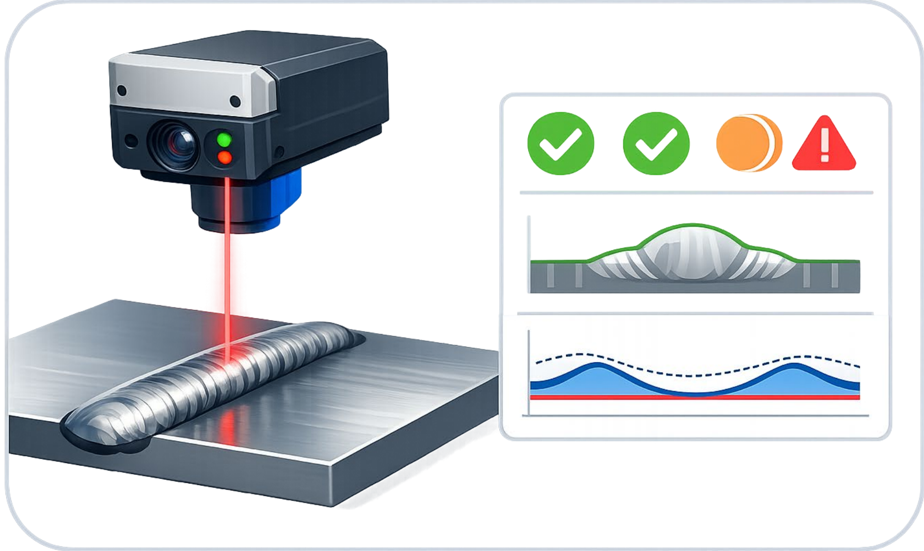
One mobile workflow closes the perception-to-path gap

The innovation is the connected workflow - not a stand-alone welding algorithm.

SENSE Detect and localize the seam or crack under defined lighting, angle, and surface variations.

PLAN Convert 3D geometry into reachability-checked approach, weld, and retreat trajectories.

VERIFY Align post-process sensor data with the planned path and create a reviewable digital record.



Two execution scenarios

Automated new welding
Welding-based crack repair

Shipyard variability keeps robot programming manual

Fixed-cell automation assumes repeatability. Shipyard work does not.

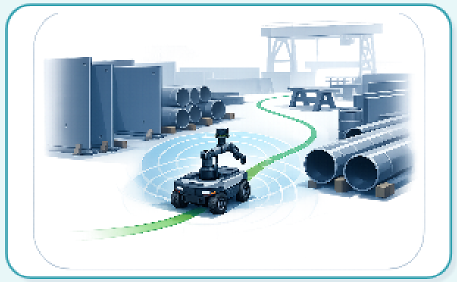
- Changing workpiece locations makes fixed setups difficult to reuse.
- Reflective steel, glare, shadows, primer, and grinding marks challenge reliable sensing.
- Manual marking and teach-pendant programming consume skilled labor before welding begins.
- Inspection data and robot paths are rarely connected in one digital workflow.

Mobility is necessary because the work does not stay in one cell.

Key gap: reliably convert sensed seam or crack geometry into an executable path without extensive manual teaching.

The proposed workflow connects four production steps

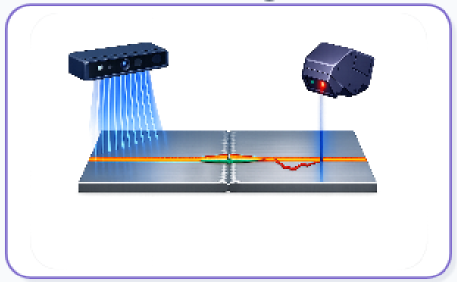
1 Navigation & Collision Avoidance



The mobile robot moves around the site, avoids obstacles, and establishes a repeatable work pose

Common to both scenarios

2 Automatic Detection & Scanning

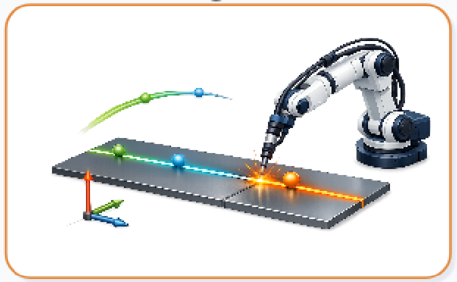


RGB-D and laser/profile sensors scan the target feature and localize the work geometry

A: weld seam detection / scan

B: weld crack detection / scan

3 Path Planning, Tracking & Execution

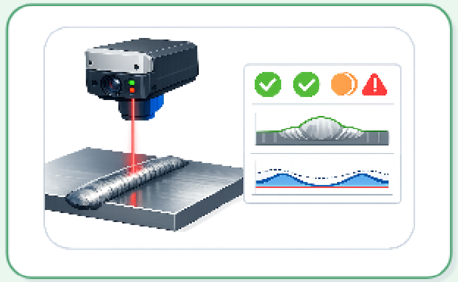


Detected geometry is converted to robot-executable paths with approach, weld, and retreat poses

A: automated new welding

B: welding for crack repair

4 Post-Inspection & Sensor Feedback



Sensors verify completion and create operator-reviewable feedback and digital records

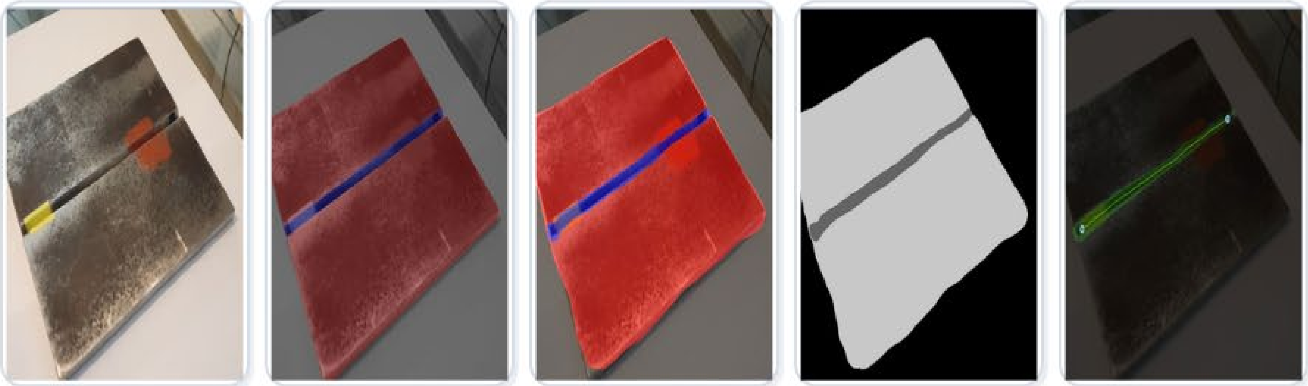
Validate the results

Scenario A - Automated Welding

Scenario B - Automatic Weld Crack Repair

The team is integrating proven technical building blocks

Prior AI seam detection and trajectory extraction



Original | Ground Truth | Prediction | Segmented | Trajectory

Input & labels → Extracted seam geometry

Prior robotic weld result

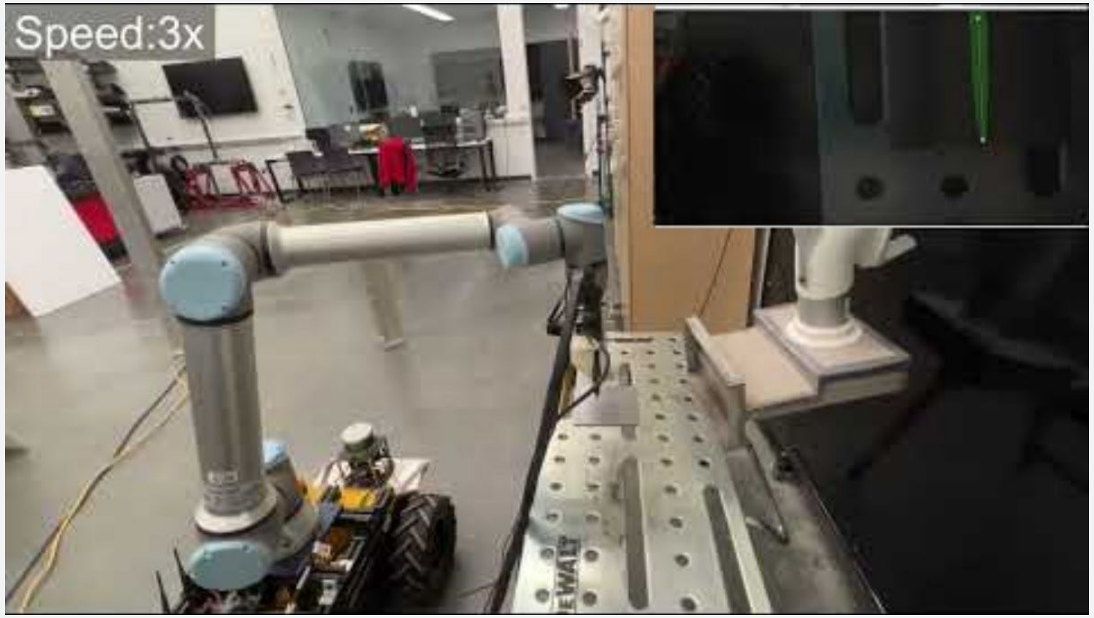
Representative robotic weld bead produced from prior trajectory generation

This prior work demonstrates the team's foundation in visual seam perception, centerline extraction, and robotic welding on laboratory butt-joint coupons. The proposed panel project retains this technical basis while extending the workflow to mobile navigation, shipyard-relevant sensing, weld crack repair scenarios, and post-process sensor inspection.

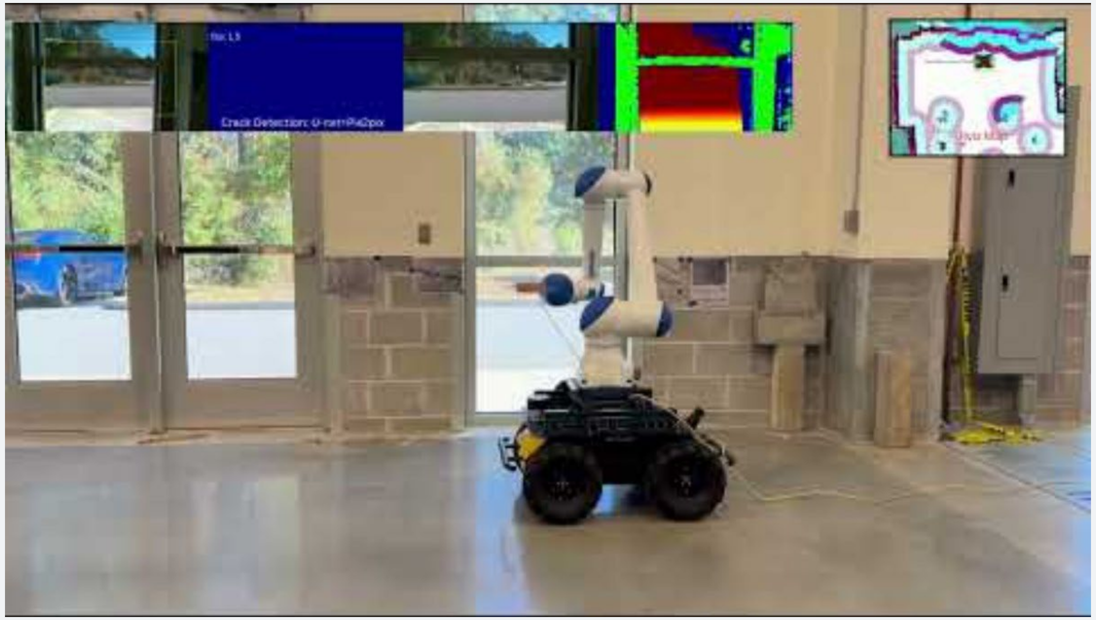
Extension, not reinvention: mobile positioning + shipyard-relevant sensing + crack repair + post-process records

Two short demonstrations show the system working

Vision-based automatic mobile welding



Automatic crack detection



Three tasks lead to an integrated 12-month demonstration

Each task ends in a measurable decision gate before the next level of integration.

MONTHS 1-4

Requirements, navigation, sensing, and AI perception

Confirm use cases and constraints; fabricate specimens; collect synchronized RGB-D and profile data; refine seam/crack perception.

Gate: requirements + dataset + perception results

MONTHS 4-9

3D localization, path generation, execution, and inspection

Register geometry to the robot; generate approach/weld/retreat paths; execute both scenarios; align post-process sensor records.

Gate: executable path + complete digital record

MONTHS 9-12

Integrated trials, validation, and technology transfer

Complete 10+ end-to-end trials; review results with shipyard personnel; deliver the final demonstration, ROI model, and transfer package.

Gate: 80%+ integrated success + transition package

Success is measured at every handoff

The demonstration is successful only when the complete sequence performs - not when one algorithm works in isolation.

PERCEPTION

90%+ F1

Seam/crack detection

<5% false positives
<=10% F1 degradation under defined lighting variation

LOCALIZE + PLAN

<=3 mm

Mean path localization error

Path generation in <=120 seconds

EXECUTE

<=5 mm

Trajectory tracking RMSE

After local registration
Pre-generated path; no live correction

VERIFY + INTEGRATE

95%+

Sensor coverage

80%+ end-to-end success
10+ validation trials
Complete record every trial

Integrated target: mobile positioning through digital record generation without manual path reprogramming.

The one-year scope is deliberately bounded

DEMONSTRATE NOW

•Representative straight butt-joint welding and crack-repair cases

•Mobile positioning, collision avoidance, and local registration

•Pre-generated approach, weld, and retreat trajectories

•Operator-reviewable post-process geometry and coverage records

DELIBERATELY DEFER

•Real-time correction of welding parameters or path during execution

•Automated defect classification, severity assessment, or acceptance

•Automatic decisions about subsequent repair actions

•Shipyard field qualification, procedure qualification, cybersecurity, and production safety approval

This boundary protects the 12-month objective: validate an integrated prototype at TRL 5 in a shipyard-relevant laboratory environment.

Shipyard input shapes both requirements and transition

DR. BISHAL SILWAL | TECHNICAL LEAD

Welding and robotic execution

Use-case integration, welding process, robot trajectory execution, and system demonstration.

DR. DOYUN LEE | CO-PI

Mobility, sensing, and perception

Navigation, multi-modal sensing, AI perception, 3D localization, and digital records.

HII INGALLS + NEWPORT NEWS

Shipyard requirements and review

Select use cases, advise on constraints and metrics, and review interim and final results.

Kickoff requirements → **Quarterly reviews** → **Interim demonstration** → **Final demo + webinar** → **Pilot planning**

Transfer package: requirements + dataset documentation + path-generation software + test results + training/calibration checklist + five-year ROI assessment

A focused $200K effort creates a low-risk bridge to pilot

The value is a reusable mobile workflow and credible transition evidence - not a one-off laboratory result.

10-20%

Target reduction in manual setup time

Localization, marking, and robot teaching for the selected use cases

TRL 3-4 to 5

Integrated prototype advancement

Validation in a shipyard-relevant laboratory environment

$200K | 12 mo

Focused panel-project investment

Three measurable tasks; no cost share requested

Expected operational value: improved repeatability, less manual programming, reduced worker exposure during selected steps, and a documented basis for a shipyard pilot.