Adaptive Intelligent Systems LLC

Develops Innovative Technologies for the Ship Building Industry

Torch Sensor Based Adaptive Intelligent Control for Circumferential Welding of Pipes

Shipyard Partners: Ingalls, Avondale, Newport News

NSRP Joint Panel Conference
Ann Arbor, MI, April 13, 2011

All Navy ships and submarines make extensive use of pipes. Welding of pipes is demanding of welder skills. Further, the majority of pipes in Navy ships are CuNi and CuNi pipes which are difficult to weld even for the most skilled pipe welders.

Major Issues:

- Most are welded manually
- High demand for skilled welders and increasing lack of skilled welder supply
- Relatively high repair rate and repair process is lengthy and costly

Need: A smart machine that can be easily used by typical shipyard pipe welders to reduce the dependence of quality assurance on their skills and operations and reduce the overall time.

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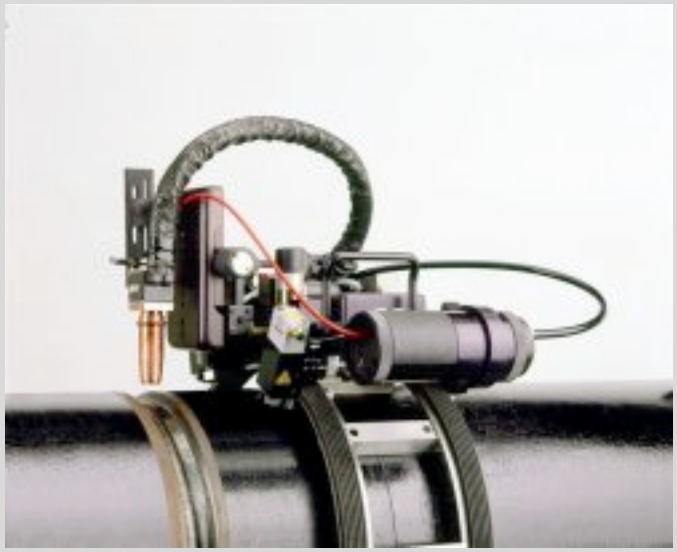
Organizations with Need

Shipyard	Location	Focus
NG Avondale	New Orleans, LA	Amphibious assault, sealift, support ships
GD Electric Boat	Groton, CT	Submarines
NASSCO	San Diego, CA	Commercial-classed, auxiliary ships
GD Bath Iron Works	Bath, ME	DDG 51, DDG 1000
NG Ingalls	Pascagoula, MS	Surface Combatants, Amphibious Vehicles, Coast Guard Large Cutters
NG Newport News	Newport News,VA	Nuclear Aircraft Carriers, Submarines, Overhaul

Manual Welding

- Years of experience needed
- Requires high concentration, labor intensive
- Accurate bevel preparation, Fit-up



Orbital Welding

- Relatively expensive equipment
- Extensive joint preparation and set-up time
- Accessibility for on-board welding

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Ideal Solution

A system that allows typical shipyard welders to produce high quality pipe welds which:

- meets quality standard - T9074-AQ-GIB-010/248 and NAVSEA WELDING AND BRAZING QUALIFICATION
- is suitable for major materials including CuNi and SS
- enables a 98% or better weld acceptance rate

In addition,

- Reduce the dependence of quality assurance on welder skills and operations
- Reduce procedure and overall time by (x%)
- Equipment cost comparable with that of current technology, Gas Tungsten Arc Welding (GTAW)
- Requires minimal training and practice
- Can be used by novice and intermediate pipe welders

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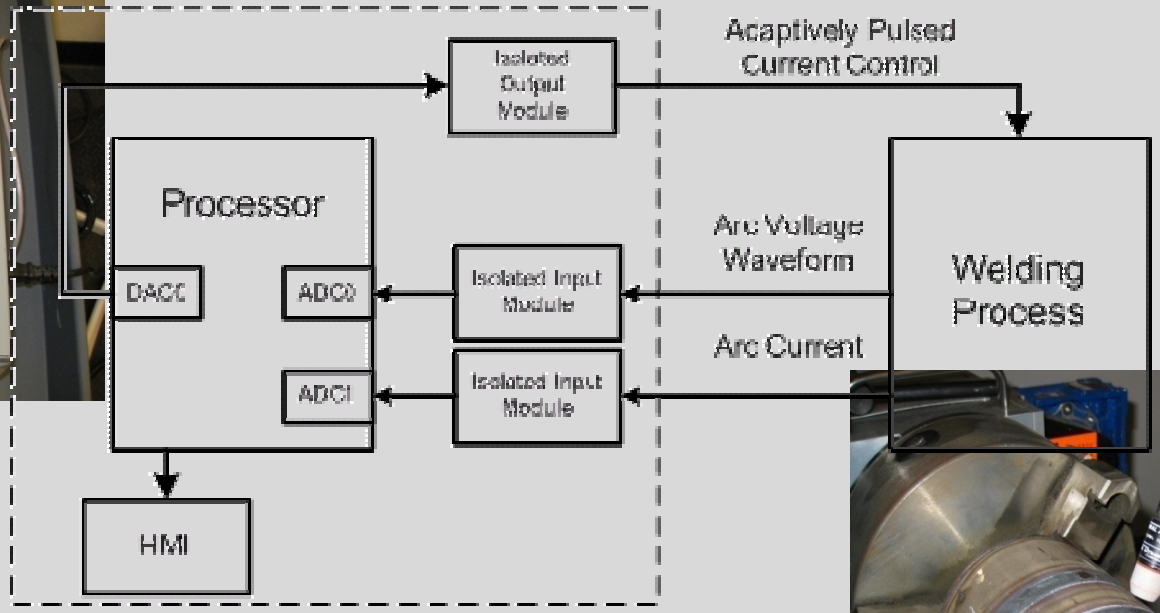
AIS Solution

1. No additional attachment to the torch
2. The welder continues to weld as normally but much relaxed
3. Human operation/actions/adjustments are much simplified
4. Human eye and concentration: replaced by measurement and busy computer processing of arc electrical signals



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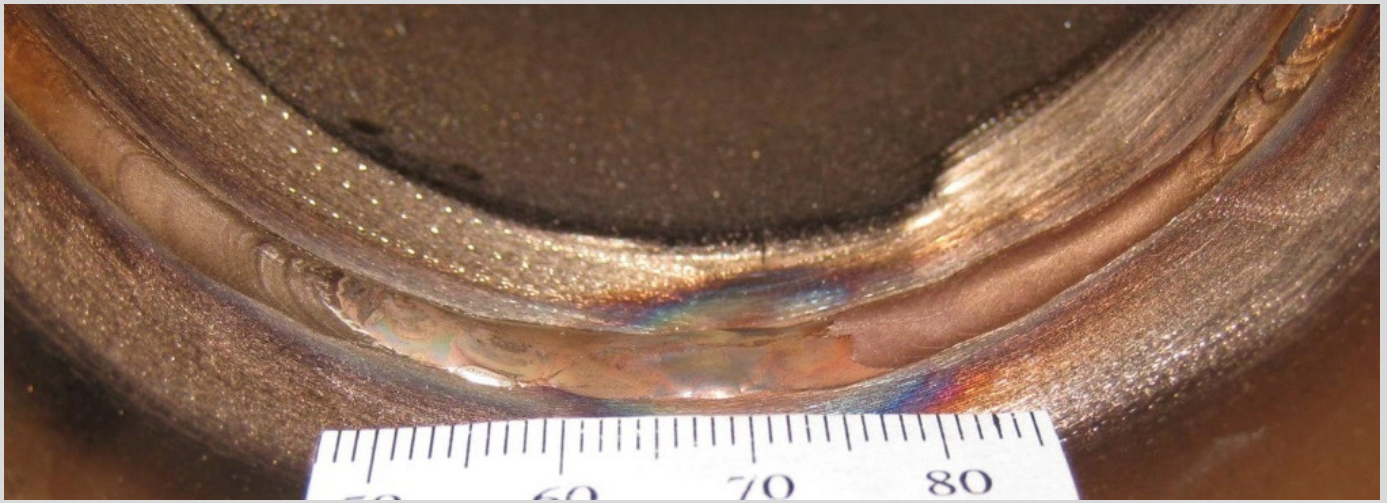
Welds using AIS Adaptive Torch Solution



Operator is Electrical Engineer with NO prior welding experience.

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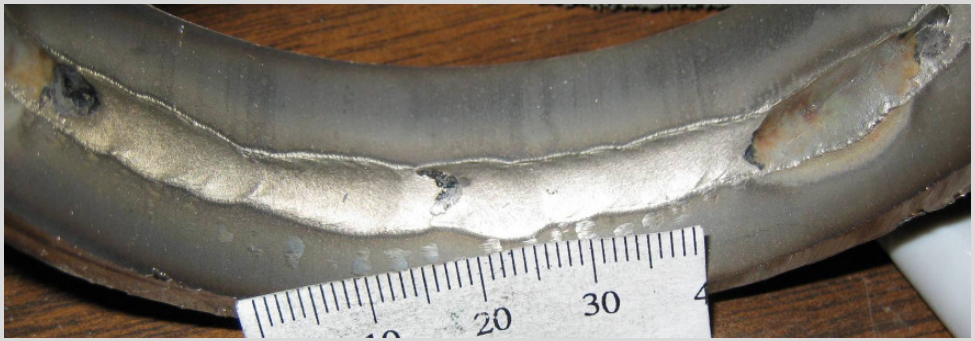
Welds using AIS Adaptive Torch Solution



Shipyard Pipe Welder

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Comparison

	AIS Sensor Torch System	Manual Operation	Orbital Welding System
Joint Preparation Needed	Least Demanding	Demanding, also require gap	Most Demanding
Equipment Set-up Time	Low	Low	High
Capital Cost	Moderate	Lowest	Very High
Rework rate	Extremely low	High	Low
Welder Skill Needed	Low	Very High	NA
Clearance needed	Low	Moderate	Infeasible in tight quarters

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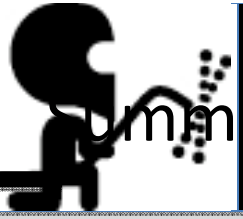

Summary

	Proved Ability (Advantage)	Work Done	Further Work or Work Needed
1	Reduced skill level: Unskilled welders can assure weld quality of full penetration without backing at fixed position (reduce training time/costs, reduce skill level needed and labor costs, help resolve welder shortage issue)	verified by unskilled (AIS engineer, PhD researcher at Carderock, Tech Warranty Holder)	Large scale tests at local welding schools and at shipyard training centers by unskilled welders
2	Preparation: Gap and groove are not mandatory and mistach is allowed for typical surface ship pipes up to 1/8" wall thickness (reduce fit-up time, reduce joint preparation time and costs)	verified by extensive tests at AIS and NGSB-GC	No further work needed
3	One pass ability: required convex bead on ID and acceptable flat or slightly convex bead on OD for typical surface ship pipes up to 1/8" wall thickness (effective welding speed trippled approxiamtely) -- In rare cases the OD is concave, second pass can be added	verified by extensive tests at AIS and NGSB-GC, nondestructive tests passed	Need destructive tests and Navy's approval
4	Accuarte penertation control (no need to use excessive heat input as a mean to assure the weld penetration ==> reduecd heat input)	verified	Need conduct systemmatical study to document
5	Attach to extsing GTAW power supply (minimal costs, easy and fast adoption and installation)	verified	No further work needed

	Tangible Ability (Advantage)	Work Done	Further Work or Work Needed
1	Help skilled welders to improve consistence (reduce repairs)	none	Large scale tests at shipyards for statatistical records
2	Improve success rate in areas with restricted access (reduce repairs, reduce labor intensity)	none	Need tests
	Areas of Improvements		Further Work or Work Needed

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Relationships Sought

Adaptive Intelligent Systems is currently actively looking for partners to help commercialize its core technology.

Shipyards are welcome to test the technology.

Strategic Partnering with Commercial Firms

- Ideally organizations experienced in marketing welding products to Naval Shipyards

Also open to a variety of relationships/deal structures

- Licensees
- Joint Venture
- Investors/Manufacturing subcontractors
- Distributors/service providers

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AIS: Company History

- Founded in Sept. 2005
- Core expertise:
  - Welding processes
  - Sensors
  - Control systems

- AIS has patents and patent applications in the area of welding methods.

- Four SBIR Phase I awards, two SBIR Phase II awards, one additional SBIR Phase II award in progress, five grants from the Commonwealth of Kentucky (matching funds).

- AIS founder is a leading expert in welding technology. He is a Full Professor of Electrical Engineering at the University of Kentucky (UK) and the Director of the Welding Research Laboratory. Dr. Zhang is an internationally recognized leader in the area of innovative welding processes and welding process sensing and control and has received a number of prestigious awards.

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