



SMALL BUSINESS
INNOVATION RESEARCH

NAVY

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TECHNOLOGY TRANSFER



Adaptive Intelligent Systems LLC

Develops Revolutionary Welding Technologies for Ship Building Industry

**Novel Arc Welding Process for Distortion Reduction and
Increased Travel Speed**

Participating Shipyards: Ingalls, Avondale, Newport News
April 13, 2011 at NSRP Welding Panel Meeting

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Motivation

Current processes used to join ship structures:

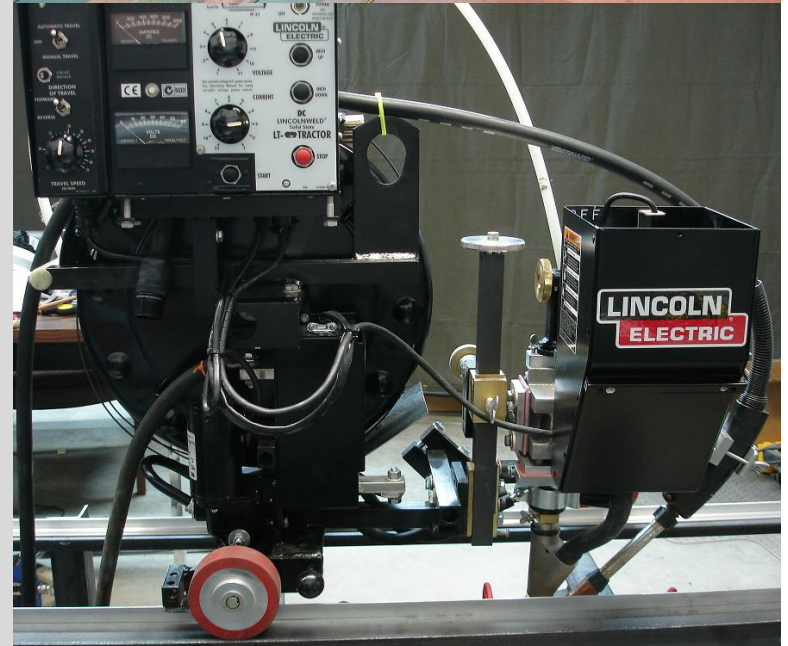
- Gas Metal Arc Welding (GMAW)
- Submerged Arc Welding (SAW)
- Flux Cored Arc Welding (FCAW)

Productivity issues with current processes:

- large heat inputs required cause distortion
- multiple pass two-sided procedure needed for thick ($>1/2''$) panels
- large gaps require a manual pre-fill

Navy Ships Yards need an affordable solution that:

1. reduces heat input and distortion
2. reduces the number of passes
3. can weld in a single pass from one side only
4. accommodates large ($1/4''$) gaps without pre work





Shipyards

- Huntington Ingalls Industries
 - Pascagoula
 - New Orleans
 - Newport News
- General Dynamics Marine Systems
 - Bath Iron Works
 - Electric Boat
 - NASSCO
- Marinette Marine
- Todd Pacific

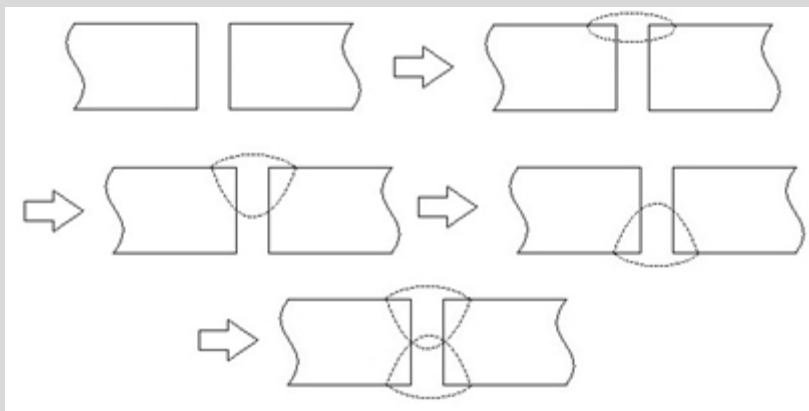
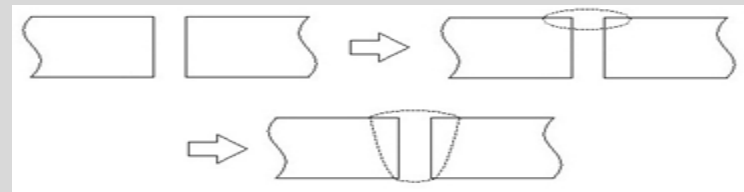
Welding Equipment Suppliers

- ABB
- BUG-O Systems
- ESAB
- ITW-Miller
Electric
- Lincoln Electric
- Magnatech
- Motoman



Single Pass Single Side Welding

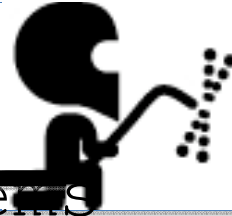
- Plates up to 3/16 inch thick
- No gap (maximum 1/16 inch)
- Ceramic back or copper backing



Two Sided Welding

- Plates up to 1/2 inch thick
- Use of large current and heat input
- No gap or pre-fill using manual FCAW

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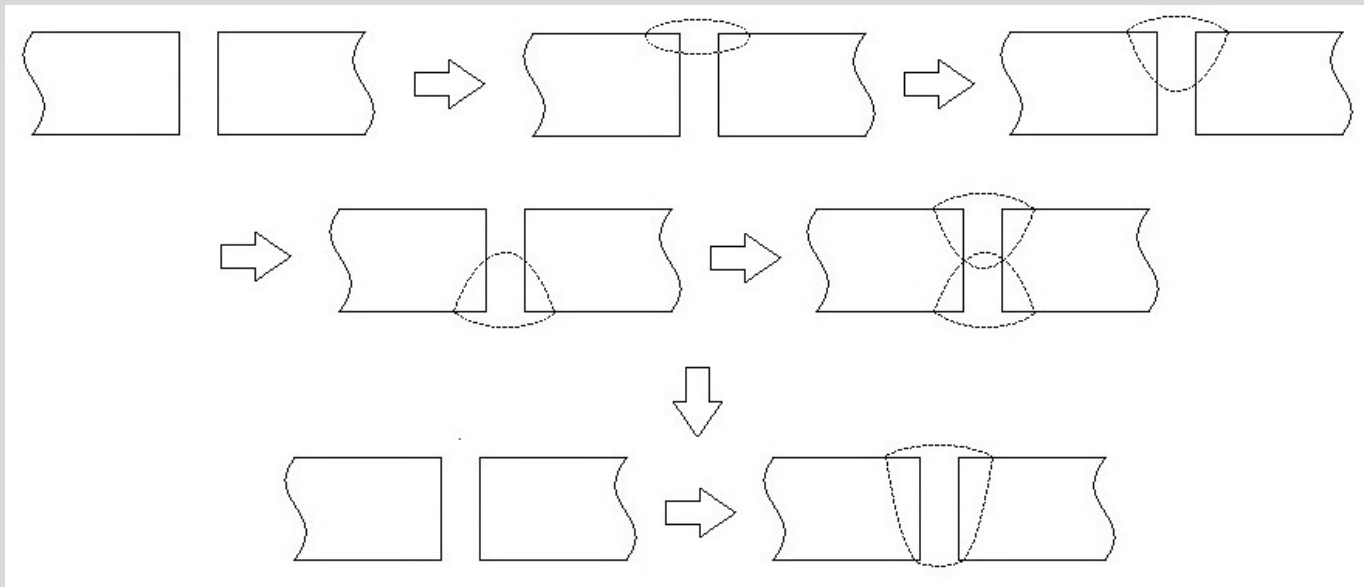
Ideal Solution

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An easy addition to existing systems to decouple deposition rate from heat input and penetration such that

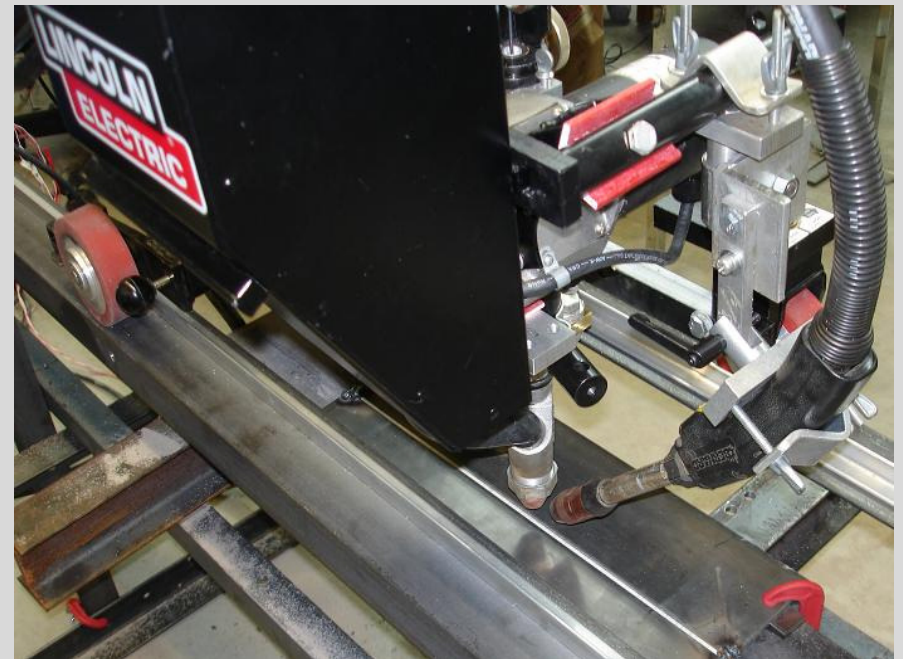
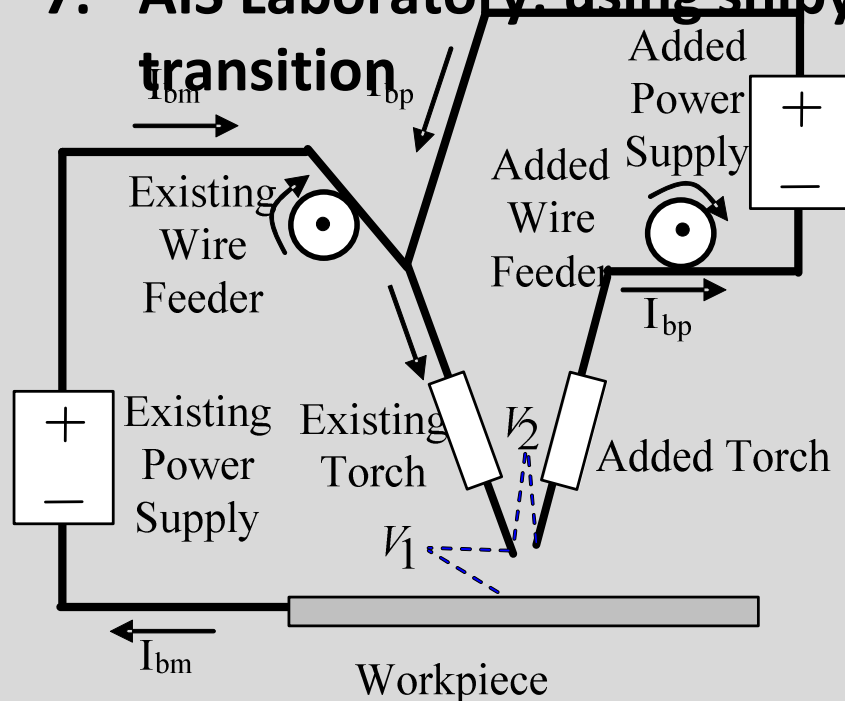
- heat input and distortion be minimized
- productivity be maximized
- large gap be tolerated
- procedure be simplified

while quality meets requirements specified in quality standards (T9074-AQ-GIB-010/248, ABS NVR, and 9074-AX-GIB-010/100) and NAVSEA WELDING AND BRAZING PROCEDURE AND PERFORMANCE QUALIFICATION





1. Add a bypass power supply, wire feeder and torch to existing system
2. Separate control of deposition rate from heat input/distortion/penetration
3. Need a fixture to attach the added torch
4. Existing system: using existing methods to set the parameters
5. Control system: adjust the parameters of the added components only.
6. Easy integration to existing system
7. **AIS Laboratory: using shipyard existing system for direct**



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Welds using AIS Bypass Torch Solution

3/16 Thin Plate: single-sided single-pass process



Benchmark using existing method: end point distortion: 51 mm



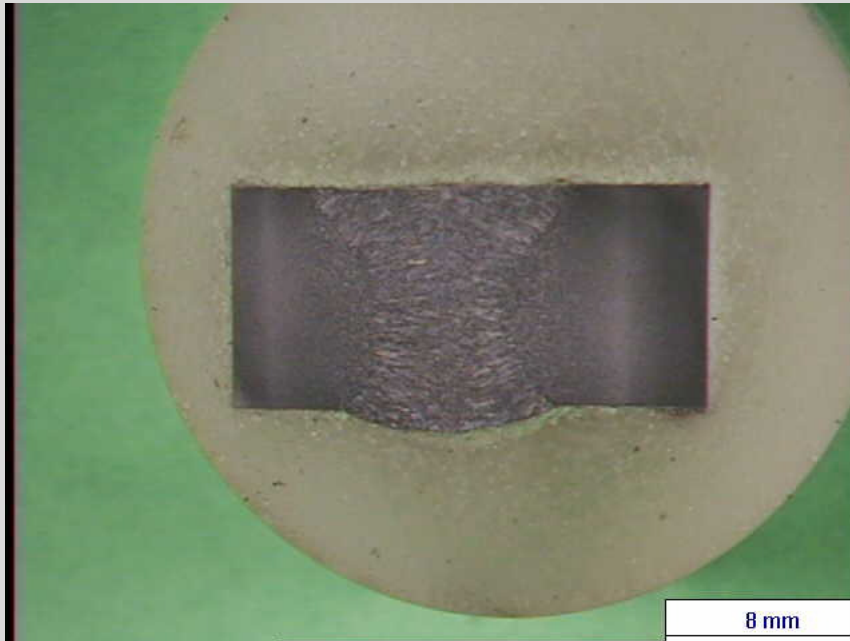
**AIS Method: end point distortion 30 mm (59% of benchmark), heat
input=63% of benchmark**

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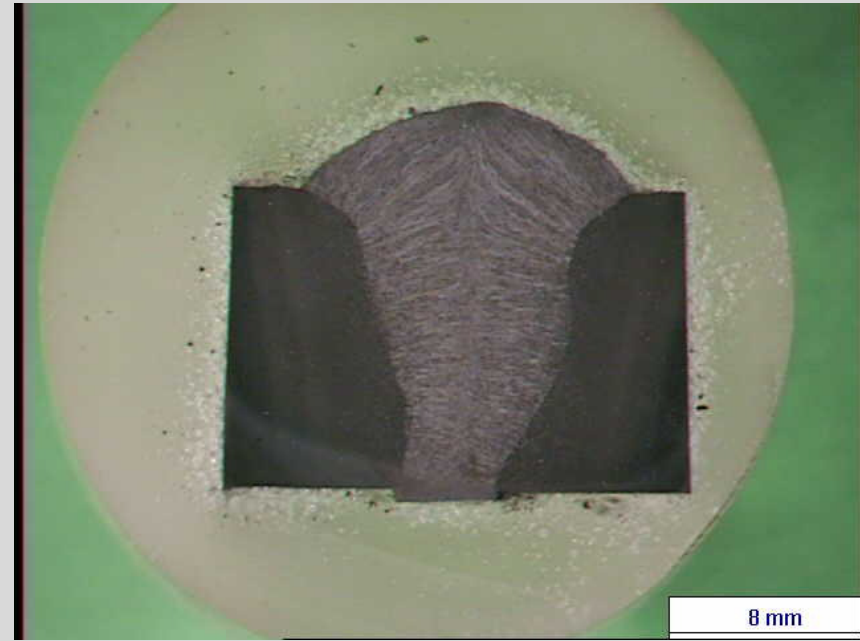


Welds using AIS Bypass Torch Solution



**AIS Single-Sided Single-Pass: 3/8 Inch thick,
1/4 inch gap, no pre-fill for the gap.**

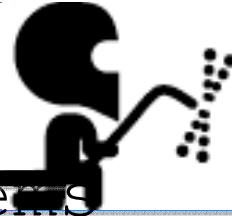
- Travel Speed: 20 IPM=shipyard benchmark for 1/2 inch thick plates
 - Single-sided and single-pass from two-sided two-pass of shipyard benchmark (productivity: at least doubled from benchmark)
 - heat input=63% of shipyard benchmark



**AIS Method for 1/2 Inch Thick Plates: 1/4
inch gap, no pre-fill for the gap.**

- Travel Speed: 20 IPM=shipyard benchmark for 1/2 inch thick plates
 - Single-sided and single-pass from two-sided two-pass of shipyard benchmark (productivity: at least doubled from benchmark)
 - Heat input=60% of shipyard benchmark

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Comparison

	Shipyard Benchmark	With AIS Additions
Plate Preparation Tolerance/Gap	1/16 inch or less	¼ inch demonstrated; larger gap to be demonstrated
Heat Input	Reference value	60% of reference
Distortion	Reference value	60% of reference for 3/16 inch plates
Action for Large Gap	Manual pre-fill	None
3/8 and ½ inch Plates	Two-sided, two-passes	Single side, single pass
Productivity for 3/8 and ½ inch Plates	Reference	At least doubled

Estimated Price: \$~10K for solution without bypass power supply; \$~15K for solution with bypass power supply

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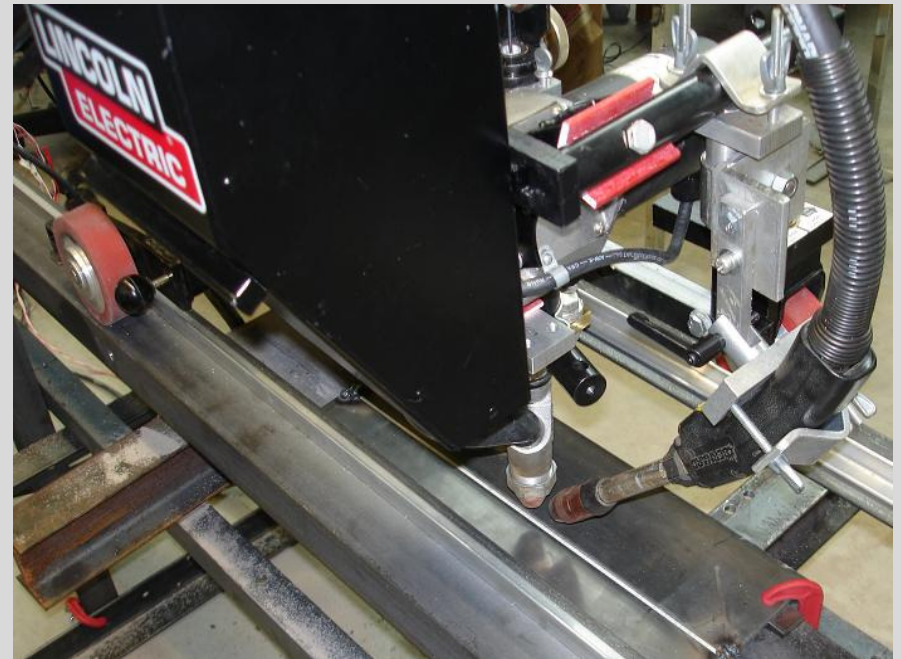
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*Current State of
Development*

TRL-6

- ✓ Prototype system demonstrated at AIS
- ✓ Prototype system tested for 12 months
- ✓ A number of welding procedures developed
- ✓ Substantial heat input and distortion reduction confirmed
- ✓ Substantial productivity improvement confirmed



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Current State of Development: Next Steps

Milestone	TRL	Risk	Measure of Success	TRL Date
Welding Procedures Established (Funded)	6	NA	Reduce distortion from current Procedures; improve productivity from current procedures	Nov. 2010
Demonstrated/Tested at Ingalls (Funded)	8	Moderate	Shipyard Acceptance	Oct. 2011
Weld Procedure Qualification (Funded)	8	Low	Meeting Requirements of ABS NVR and T9074-AQ-GIB-010/248	Dec. 2011
Initial Technology Insertion (To Be Funded)	9	Moderate	Shipyard Acceptance and NAVSEA TWH Approval Granted	Dec. 2012

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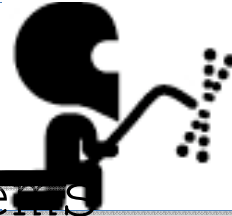


About AIS

Intelligent Systems

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

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