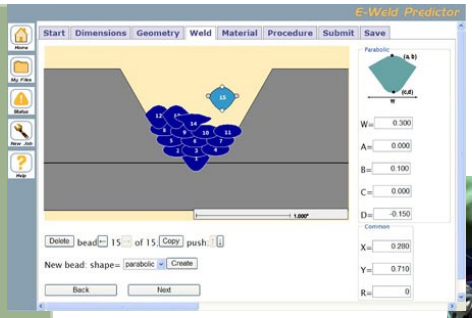
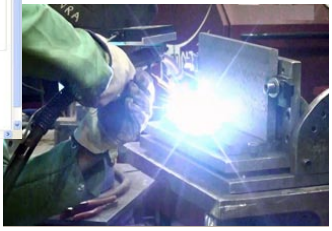
CRP

2009/2010 Cooperative Research Program





EWI's mission is to *Advance Our Customers' Manufacturing Competitiveness through Innovation in Joining and Allied Technologies*. The Cooperative Research Program (CRP) supports this mission by investing in key technology areas to strengthen EWI's capabilities to address industry's current and future needs. The CRP is a portfolio of EWI research projects that are selected annually with input from the EWI Industry Advisory Board (IAB). The IAB includes technical professionals from member companies in a range of industry sectors and provides guidance on technology needs, as well as the value of potential solutions. CRP results are available to all EWI members so they may take advantage of the latest advances in materials joining and allied technologies to enhance productivity, quality, and performance.

The 2009/2010 Cooperative Research Program encompasses a range of materials joining and allied technologies with relevance to many industry sectors. This flier summarizes the objectives of each CRP project. Feel free to contact EWI if you would like to learn more about a specific research project or the CRP program in general. For more information about a specific project, contact the principle investigator listed for the project. For suggestions of future topics or questions about the CRP program, please contact EWI's Chief Technology Officer, Chris Conrardy (chris_conrardy@ewi.org).

Welder Training Device Field Validation

Objectives: Many industry sectors report a critical shortage of skilled arc welders. Previous work at EWI explored the use of real-time sensory feedback to create a coaching environment to promote self-correction for new welder training. A prototype non-contact vision system that measures torch angles and speed while welding was constructed. This work will construct of a more robust beta system for testing in a relevant environment. Field testing will be conducted at a partner training facility to evaluate the benefits of the system, including measurement of how effective the system is at reducing training time and cost.

Start Date: 7/1/2009 **End Date**: 6/30/2010
EWI Contact: Matt Penrod **EWI Ref.**: 52142-GTO
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Ultrasonic Machining of Advanced Alloys

Objectives: In FY09, a novel prototype high-speed ultrasonic drilling system was assembled and initial testing performed to assess the performance improvements relative to conventional drilling. It was found that drilling productivity can be greatly increased. This work will test a range of difficult-to-machine base materials to more fully assess productivity, quality, environmental (reduced lubricants), and cost benefits over conventional machining practice.

Start Date: 7/1/2009 **End Date**: 6/30/2010
EWI Contact: Matt Short **EWI Ref.**: 52146-GTO
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Fiber Laser Hybrid Laser-Arc Welding Optimization

Objectives: With the rapid advancement of high-power solid-state lasers, hybrid laser-arc welding is becoming a viable option for many new applications. Hybrid laser-arc welding can increase productivity by a factor of five or more over conventional GMAW. The productivity increase can be from the deep penetration or faster travel speeds provided by hybrid welding. Due to a low heat input and fast cooling rate, hybrid welding presents unique advantages and challenges for various structural materials. This project will examine hybrid welding of steel, aluminum, and titanium for both high-speed and deep-penetration applications, as well as evaluate the mechanical properties of thick-section hybrid welds in high-strength low-alloy steel.

Start Date: 7/1/2009 **End Date**: 6/30/2010
EWI Contact: Brian Victor **EWI Ref.**: 52145-GTO
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On-line Numerical Modeling of Welding Processes

Objectives: In FY08-09, EWI developed an improved version of the EWI WeldPredictor™ online arc weld modeling software for predicting weld properties. The improvements were based on feedback from a group of over 100 industrial users. This work will further test and validate the models, develop user documentation, and make the software available for use on EWI's member website. This engineering tool will assist in the decision making process during product design, development, and manufacturing.

Start Date: 7/1/2009 **End Date**: 6/30/2010
EWI Contact: Yu-Ping Yang **EWI Ref.**: 52148-GTO
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Friction Stir Welding (FSW) of Hard Metals

Objectives: Industrial application of FSW is primarily limited to relatively soft materials, such as aluminum alloys. EWI has also successfully demonstrated FSW for some relatively hard materials, such as 12-mm thick steel and titanium alloy plate. Work in FY09 concluded that there are two types of tool degradation: wear and deformation. While wear plays a role with chemical, abrasive, and adhesive interactions; for the conditions tested, deformation was the most significant mechanism. The project also concluded that material composition and processing play a significant role in how a material degrades. This work will investigate new material compositions for their application in the FSW of steel, titanium, and nickel alloys. Tool degradation mechanisms will be characterized and classified using the protocol developed in the previous work.

Start Date: 7/1/2009 **End Date**: 6/30/2010
EWI Contact: Brian Thompson **EWI Ref.**: 52143-GTO
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EWI
Joining Innovation

Joining Dissimilar Materials: Aluminum to Steel

Objectives: Dissimilar metal joints are used in many industries to achieve needed combinations of corrosion, mechanical, and high-temperature performance, while controlling overall system cost. Work in this program will focus on scaling the friction welding process for joining aluminum to steel from the smaller diameter bars and thinner wall thickness tubes to larger diameters (> 4-in.) and thicker walls (> 0.5-in.). Intermetallic formation at the bond line can degrade the mechanical properties achieved in a joint. In a previous CRP program, the mechanisms of intermetallic formation were identified for smaller cross-sectional area friction welds. Data from that program will be used to extrapolate the process to joint diameters and wall thicknesses not typically attempted with friction welding.

Start Date: 7/1/2009 **End Date**: 6/30/2010
EWI Contact: Wendell Johnson **EWI Ref.**: 52147-GTO
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Novel Matrix Phased-Array UT Tool Development

Objectives: The goal of this project is to enhance detection and sizing accuracy of crack-like and planar imperfections using matrix phased-array (MPA) ultrasonic tools. This program will develop a concept for using MPA ultrasonic probes/modules for inspection of pipe from the outside and inside pipe surfaces and carried by different inspection platforms or systems. The program will look at detection and sizing of fabrication flaws, as well as in-service damage in carbon steel pipelines. Two prototype MPA modules will be designed, built, and evaluated. If successful, the MPA technology could be extended to a wide range of structural applications.

Start Date: 7/1/2009 **End Date**: 6/30/2010
EWI Contact: Roger Spencer **EWI Ref.**: 51433-GTO
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Control of Springback in Bending and Flanging AHSS

Objectives: Springback is a critical problem in fabricating industries that form and weld metal sheet and plate. Springback is known to have a complicated nature related to material properties, stress-strain variables, part geometry, and friction with forming tools. This project will investigate methods to control springback in bending and flanging advanced high strength steels (e.g., DP600, DP780, DP980 and TRIP780). Finite element prediction models will be used and the results compared with the experimental data using V-bending, rotary bending, and S-rail curved flanging tests. Recommendations to reduce and compensate for springback will be reported.

Start Date: 7/1/2009 **End Date**: 1/29/2010
EWI Contact: Hyunok Kim EWI Ref.: 52149-GTO

High-Power Ultrasonic Additive Manufacturing (UAM) Bond Characterization

Objectives: UAM is a solid-state metal deposition process that allows build-up or net-shape fabrication of metal components. Currently the process is limited to relatively soft metal alloys, such as aluminum and copper. A higher-power UAM system is being developed to assess whether harder materials can be deposited with UAM. This project will study the bonding mechanisms involved to assess whether high-integrity build-ups on hard materials are practical.

Start Date: 7/1/2007 **End Date**: 6/30/2010
EWI Contact: Mark Norfolk **EWI Ref.**: 50718-IRD
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Multifunctional Composites with Embedded Sensing and Stiffness Controls

Objectives: This investigation will explore the use of UAM to fabricate "smart" materials with embedded sensors, actuators, or stiffness control mechanisms. Several variations of Ni-Ti/Aluminum composites will be manufactured and evaluated. The program will focus on building composites by embedding magneotorestrive materials in an aluminum matrix. Subsequently, the materials will be studied to understand the processing/properties relationship from the point of view of the bulk electro-thermo-mechanical and metallurgical properties of the composites.

Start Date: 7/1/2007 **End Date**: 6/30/2010
EWI Contact: Mark Norfolk **EWI Ref.:** 50719-IRD
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- **Technical Meeting and Tours at EWI**: Bring us your design problem, weld problem, technical or general questions and we'll match your team up with staff members to help.
- **Access to EWI Member Central Web Site**: Submit library requests, send technical inquiries, view detailed reports, obtain Cooperative Research Program results, and more.
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For More Information:
contact our Membership Services Office
(614) 688-5000 or membership@ewi.org

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