Research focuses on the development of innovative material joining processes and sensors/control systems for manufacturing processes. Recent inventions and developments include dynamic keyhole plasma arc welding process, double-sided arc welding process, plasma arc flexible forming process, nontransferred microplasma sensor, arc light sensor, and efflux plasma charge sensor. These inventions and developments have resulted in four U.S. patent awards, several university invention disclosures, and many publications.

### Recent Projects (1997-Present)

**Double-sided arc welding**

**Research Team**
- **PI:** Dr. YuMing Zhang
- **Participating Faculty:** Dr. Alan Male, Professor
- **Postdoctoral Researchers:** Dr. Shaobin Zhang and Dr. C.X. Pan
- **Research Assistants:** Ming Jiang, Breton Losch and Jason Philips
- **Sponsor:** NSF

**Intelligent control of robotic welding**

**Research Team**
- **PI:** Dr. YuMing Zhang
- **Postdoctoral Researchers:** Dr. Pengjiu Li and Dr. Shaobin Zhang
- **Research Assistants:** Jason Philips and Yuchi Liu
- **Sponsor:** Progressive Systems

**Weld penetration control based on vision feedback of weld pool geometrical appearance**

**Research Team**
- **PIs:** Dr. Alan T. Male and Dr. YuMing Zhang
- **Postdoctoral Researcher:** Dr. Lin Li
- **Research Assistant:** Lin Li
- **Sponsor:** NSF

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**Double-sided arc welding process automatically minimizes the heat input and penetrates thick material in a single pass.**

**Welding longitudinal seams in mild steel pipe using double-sided series arc process**

**Research Team**
- **PI:** Dr. YuMing Zhang
- **Postdoctoral Researcher:** Dr. Shaobin Zhang
- **Sponsor:** The Lincoln Electric Company

**Real-time adaptive control of automated gas tungsten arc welding for complex shaped parts**

**Research Team**
- **PI:** Dr. YuMing Zhang
- **Postdoctoral Researcher:** Dr. Pengjiu Li
- **Research Assistant:** Lin Li
- **Sponsors:** Navy Joining Center and Army Aviation Systems Command

**Improved hole manufacturing for coated cylindrical structures**

**Research Team**
- **PI:** Dr. YuMing Zhang
- **Postdoctoral Researcher:** Dr. Shaobin Zhang
- **Sponsor:** Pratt & Whitney

**Improved sheet metal forming of nickel base alloys**

**Research Team**
- **PIs:** Dr. YuMing Zhang and Dr. Alan T. Male
- **Postdoctoral Researcher:** Dr. Pengjiu Li
- **Research Assistant:** Yiwei Chen
- **Sponsor:** Pratt & Whitney

**Double-sided arc welding process achieves narrow deep penetration that normally requires laser or electron beam welding processes.**
Welding Research Laboratory and Applied Sensing and Control Laboratory

Program Director: Dr. YuMing Zhang, Associate Professor

**Patents**

Method of arc welding using dual serial opposed torches

Method and system for gas metal arc welding
Y. M. Zhang and Ligueo E., 1999, U. S. Patent, No. 6,008470

Method for gas metal arc welding

Apparatus and method for measuring 3D weld pool shape

Nontransferred plasma arc based sensor for seam tracking

Efflux plasma charge sensor for weld joint penetration in keyhole plasma arc welding
Y. M. Zhang and S. B. Zhang, University of Kentucky Invention Disclosure, March 1999

**Recent Publications (1998–Present)**

“Improvement of microstructures and properties of 6061 aluminum alloy weldments using double-sided arc welding process,” Y. M. Zhang, C. X. Pan, and A. T. Male, accepted for Metallurgical Transactions

“Precision sensing of arc length in GTAW based on arc light spectrum,” P. J. Li and Y. M. Zhang, accepted for ASME Journal of Manufacturing Science and Engineering, Feb. 28, 2000


*Dynamic keyhole plasma arc welding process automatically overcomes the variations in heat sink and material thickness.*