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## **Research Story**

### **Revolutionizing Additive Manufacturing: IIT (ISM) Dhanbad Develops Twin-Wire Setup for 3D Printing with In-Situ Alloying; The Innovative Product Stands as a Testament to India's Growing Expertise in Additive Manufacturing; Paves the Way for a More Efficient and Sustainable Future in Metal Fabrication**

Additive Manufacturing (AM) has emerged as a transformative technology in the manufacturing sector, enabling the production of complex metal components with minimal lead time. The ability to fabricate large and intricately designed metallic structures using a layer-by-layer deposition approach has revolutionized conventional manufacturing processes. Among various AM techniques, Wire Arc Additive Manufacturing (WAAM) stands out due to its high deposition rate and cost-effectiveness, making it an attractive choice for industrial applications.

In a significant advancement, the Department of Mechanical Engineering at the Indian Institute of Technology (Indian School of Mines), Dhanbad (IIT-ISM), has successfully established a twin-wire AM setup integrated with in-situ alloying capabilities. This state-of-the-art system incorporates a Yaskawa six-axis industrial robot, designed for precision and efficiency. The setup comprises key components, including:

- **Manipulator:** Ensures precise movement and handling of the deposition process.
- **Controller (YRC 1000):** Coordinates the robot's motion and the welding process.
- **Programming Teach/Play Pendant:** Facilitates the definition of torch paths for accurate deposition.
- **Manipulator Cables:** Ensure seamless communication between components.
- **Gas Tungsten Arc Welding (GTAW) Power Source:** Integrated for superior control and quality of metal deposition.
- **Wire Feed System:** Enables the deposition of in-situ alloying elements to enhance material properties.

The MOTOMAN robot-assisted software further augments the system's capability to achieve high-precision deposition, ensuring superior mechanical properties of the fabricated components.

### **Research and Industrial Impact**

This pioneering project is funded by the Science and Engineering Research Board (SERB), Government of India (Project Code: EEQ/2021/000184). The research outcomes have been published in internationally acclaimed journals, showcasing the effectiveness of the developed AM setup. Additionally, the innovative design is currently under evaluation for patent approval, further solidifying IIT (ISM) Dhanbad's contribution to cutting-edge manufacturing technologies.

The department is actively engaged in ongoing research to develop multi-material components applicable across various industries, including aerospace, automotive, and heavy machinery repair. The ability to fabricate and repair critical components using this advanced setup presents a game-changing opportunity for manufacturing and maintenance sectors.

### **Knowledge Dissemination and Industry Collaboration**

Recognizing the importance of knowledge sharing and skill development, the Advanced Manufacturing Lab at IIT (ISM) Dhanbad is open to school students, college students, entrepreneurs, and industry professionals.



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Visitors are encouraged to explore the innovative AM setup through scheduled visits, which can be arranged via email (available on the institute's website).

A key objective of this initiative is to promote awareness among the youth and entrepreneurs of Jharkhand, fostering a culture of technological advancement and industrial growth. By demonstrating the potential of in-situ alloying and AM, the institute aims to inspire future innovations and collaborations in the field of advanced manufacturing.

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