



**INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS**

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Thesis Title: Computer-Aided Process Planning for Wire Arc-Based Directed Energy Deposition

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SHORT ABSTRACT

This thesis focuses on the hybrid Wire Arc-based Directed Energy Deposition (H-WADED) process, which integrates additive and subtractive manufacturing to efficiently produce large, complex metallic components. A novel Computer-Aided Process Planning (CAPP) framework is developed, supporting various CAD formats and unconventional toolpaths, resulting in up to 71% material savings and 91% reduction in build time as compared to subtractive manufacturing processes. Three substrate utilization methods—reusable, embedded, and integrated—are proposed, significantly reducing material waste. The embedded method saves up to 64% of material. A novel approach for fabricating density-based Functionally Graded Materials (FGMs) is introduced by drilling holes to achieve engineered density, reducing mass and thermal conductivity. A Robotic WADED (R-WADED) system is developed for large-scale, on-site fabrication. The thesis presents a trochoidal toolpath for rapid, uniform deposition, improving mechanical properties like hardness, tensile strength, elongation, and wear resistance, while significantly reducing build time and wear. This toolpath enhances the WADED process's efficiency and effectiveness.