Proceedings of the Canadian Society for Mechanical Engineering International Congress 2022
CSME Congress 2022
June 5-8, 2022, Edmonton, AB, Canada

Zero Programming Laser Cladding Repairs

Daniel Ramirez[1], Syed Alam[2], Patricio Mendez[1,3*]
[1]Department of Chemical and Materials engineering, University of Alberta, Edmonton, Canada
[2]Department of Chemical and Materials engineering, University of Alberta, Edmonton, Canada
[3] Department of Chemical and Materials engineering, University of Alberta, Edmonton, Canada
*danielro@ualberta.ca, sialam@ualberta.ca, pmendez@ualberta.ca

ABSTRACT

Laser cladding has found intense use in the manufacturing industry, thanks to its capabilities of rebuilding pieces with tailored and enhanced properties. This has led to an increased necessity of correctly control one or multiple of the involved parameters in this process where only a small number of automation procedures have found their way into daily production.

The area of control that deals with this type of processes is process control. Obtaining the best result translates into an optimization problem. Today, this problem is often being tackled with rules of thumb procedures, which limits production rates, flexibility and produces restrictions in hardware and materials. Our methodology reduces the input from the on-site engineers for manually tuning design parameters during dry runs and tests, increasing engineering efficiency and practicality.

The Canadian Centre for Welding and Joining (CCWJ) commissioned a highly automated laser cladding system. It has been used to remanufacture high-value components with a streamlined workflow using an optical coordinate measuring machine and parametric programming. The system outputs robot code with highly embedded control of dimensional accuracy, laser power, beam velocity, and powder feed rate using a distributed control topology.

This approach centers its attention on the remanufacturing of parts and its inherent complex surface as well as the time-consuming task of programming the robot to construct toolpaths for the cladding strategy. These issues are solved using a set of topologies implemented for the first time together and applied to this area of engineering. The integration of technologies is done at software and hardware levels to deliver a system capable of integrating the control parameters and the tooltip toolpaths into a highly automated system offering versatility, scalability, and reproducibility.

To validate the system integration real parts with field produced worn areas from the heavy oil industry where fed to the system. Results show the capacity of the system to deliver short time programming sequences with integrated process constraints, precision, and high dimensional accuracy.

Word count: 398