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Calculation and design of supersonic nozzles for cold gas dynamic spraying using MATLAB and ANSYS Fluent.

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Abstract

One of the most daunting challenges in the Cold Gas Dynamic Spray (CGDS) process is the calculation and design of the nozzles that are used to accelerate the gas and the powder particles at supersonic speeds and so promote the deposition process. Past research into this area resulted in a wealth of knowledge but unresolved problems still exist. The actual calculations and designs of the CGDS nozzles are considered large, complex, and time consuming. Consequently, this dissertation develops a new software that focuses on the simulation of the gas and particles velocities for a large variety of CGDS process parameters. However, in order to achieve this, an unified mathematical model of various cold spray parameter was developed. Thereafter, a new software using MATLAB was developed to generate practical graphs for the CGDS process and generate the 2D recommended nozzle contour, and the Computational Fluid Dynamics (CFD) software was used to calculate and visualize the gas flow. Then, the results obtained using the two developed technologies were compared with data from the peer reviewed journal papers and it was found that the results obtain using the new MATLAB software and ANSYS Fluent were very similar with data found in the literature survey. The dissertation ends with conclusions about the new approach for the calculation and design of the CGDS nozzles, and finally highlights its theoretical and practical implications.