# Numerical study of the gas-powder flow behavior and its laser interaction with diverse coaxial nozzles (Sim-AM 2019)

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## ABSTRACT

The Laser Metal Deposition process (LMD) is a rapid free form fabrication method, which generates near net shape structures through the interaction of a laser beam and a metallic powder jet. Nowadays, this cladding technique is increasingly used to add coating or functions on new metallic parts or to repair used ones. One of the main difficulties of this process is the large number of relevant parameters, which affect the size, regularity and productivity of the created deposit. Moreover, multiple previous studies showed the importance of a known and controlled gas-powder jet to effectively predict and understand the deposit. Therefore, a deep knowledge of the process powder supply behavior and its laser interaction is necessary.

In this study, a simplified numerical model was carried out to predict the gas-powder mixture behavior from three diverse coaxial nozzles. According to their conical shape, 2D axisymmetric two phases flow models were performed, where the primary phase is the gas and the secondary phase consist of the powder particles. Results showed the impact of nozzle design, gas and powder flow rate on the jet diameter, particle distribution and focal plan position.

By measuring the powder jet features with two compatible setups, the gas-powder behavior was also experimentally evaluated and compared to the simulation results. Furthermore, the laser beam attenuation by the powder particles jet was experimentally investigated and linked to the previous jet features. Results outlined a significant impact of the working distance, powder and gas flow rate, while the laser power doesn't seem play a key element. All those results allow a more accurate picture of the gas-powder flow behavior and, then, of the process.

## KEY WORDS

Laser Metal Deposition, coaxial nozzle, gas-particle simulation, laser beam attenuation, experimental setup