



## Master thesis proposal

### Data analysis for aerospace coating prediction in plasma spraying

**Keywords:** data collection, sensors, unstructured data, feature extractions, material deposition process

#### SCIENTIFIC DESCRIPTION:

GRENAT project addresses the topic on the acceleration of the mastery of synthesis and shaping processes of DIADEM PEPR relying on the technological platform SAFIR of advanced surface functionalization hosted by the Institute of Research for Ceramics (IRCER, University of Limoges). Thermal spraying is a family of coating processes that uses a source of enthalpy and momentum to spray materials to form a coating from stacking of lamellae, which the thermo-kinetic state upon impact with the substrate determines the coating's properties. The large number of process parameters, their coupled and non-linear effects on the treatment of particles make complex the experimental process optimization and the implementation of numerical modeling. Artificial Intelligence is an alternative way of optimizing such a deposition process using data generated by sensors and advanced diagnostic systems. The three key subsystems governing 1) heat and momentum generated by the plasma torch, 2) heat and momentum transfers to particles, and 3) coating formation must be monitored by means of appropriate sensors (voltage, current, acoustics and light fluctuations signals, plasma images and coating material properties) covering different scales of sampling rates, various data formats and grasping phenomena over different scales of time (from  $\mu$ s to min). Moreover, the data information is collected during all over deposition time on a moving substrate to form a coating. This methodology associated with the technical constraints of material deposition require several key objectives that will correspond to the outcomes of this Master 2 internship. They encompass i) the capture of data stream from the sensors and their synchronization with the deposition time stamp, ii) the analysis of unstructured data sets, iii) the features extraction.

#### Techniques/methods in use

First, data will be collected for a set of operating parameters determined in the frame of GRENAT project at the SAFIR platform of the IRCER institute. Second, data preprocessing should be developed for each modality corresponding to each acquisition framework including signal filtering, noise reduction, statistical analysis (spectrograms, waveform embeddings, statistical features, or possibly CNN for images, ...). Second, the features must be studied and represented after normalization and possible reduction in the process time line. Third, the multisensor fusion strategy must be developed including the fusion architecture, the relationships between features and their possible combination in a framework that should be interpretable by the deposition experts.

**Applicant skills :** Education in mechanical engineering, computer science or data science, technical skills in signal processing, machine learning, software (python, Pytorch, TensorFlow, ...). Soft skills: teamwork, communication, adaptability to engineering problems and industrial framework.

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