Over the last decades, artificial intelligence has been successively introduced to scientific applications. Proposed machine learning algorithms are used not only for the identification of handwriting or voice recognition. In this project, the AI prediction potential is exploited in the field of thermal spraying. Current scientific interest in this field is focused on the possibility of controlling the spraying process by predicting the hardly measurable spraying properties.

In this project, AI algorithms are used to predict the inflight properties of suspension feedstock during the suspension plasma spraying process (SPS). This will help to understand the feedstock history, which leads to the deposition of specific coatings with different morphologies and resulting properties. We cannot control the inflight properties of the coating material directly. However, understanding how they are correlated with the spraying conditions will be the first step of the AI-aided design of coatings sprayed by means of suspension plasma spraying. It is not as simple as the use of a commercially available diagnostic system to corelate the feedstock properties with the operational conditions of the plasma torch or suspension feeder. Inflight properties are hardly measurable. It is possible to measure only the average velocity or temperature of inflight droplets using advanced two-color pyrometry systems or the 'shadowgraphy' technique during SPS. Although it is possible to predict the behavior of an individual droplet using the finite element method (FEM), it is usually introduced to a single case analysis due to the extensive computational cost. The introduction of artificial intelligence opens the possibility of expanding the range of SPS process parameters investigated simultaneously and the number of predicted suspension inflight properties once the AI is trained.

However, the liquid feedstock behavior is experimentally investigated in this project, and the FEM computations are also introduced to the study. Experimental techniques are used here to validate the AI algorithms and the results of FEM computations will be collected as an AI training dataset. When compared to the classical regression models, AI algorithms show the undeniable superiority in the prediction of the nonlinear phenomena such as those occurring during the SPS. However, one of the biggest challenges in the introduction of AI algorithms is the amount of data required for the AI training procedure. Therefore, it is proposed to use the computational approach to collect training data. It is economically feasible to pay for the computational cost instead of the cost of extensive experiments. On top of this, the current technology allows for prediction only of the average feedstock properties, as mentioned. Nevertheless, the computational methods need to be experimentally verified. Thus, the experimental approach is also considered in this project for validation purposes.