

# Application of Deep Learning Convolutional Neural Network for Spray Characterization

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**Abstract** – The application of a machine learning artificial intelligence (AI) for spray characterization is investigated. Images of sprays in regions where droplet formation has not taken place, therefore not allowing any insight into the spray droplets themselves. The objective is to bridge the gap from the process of droplet formation to the characteristics of the spray that is produced at the end of this process. To achieve this, convolutional neural networks (CNN) are trained to classify images of sprays that were captured at different operating fluid pressures. Even though this is not directly characterizing the spray, it provides evidence for the potential of machine learning methods in spray characterization as distinctions are made prior to spray formation meaning CNNs are able to distinguish patterns in sprays prior to the droplet formation process, hence proving the possibility of bridging the aforementioned gap. Our models were able to accurately identify images of sprays taken at different operating pressures. Moreover, the convolutional neural networks were further analysed to understand how they were able to make these distinctions, that are not easily visible to the human eye. For this gradient class activation maps were determined to understand the inner workings of the convolutional neural networks. These gradient class activation mappings could prove useful in determining new physical patterns that were previously unknown, which could contribute to a better understanding of sprays and the droplet formation process.

**Keywords:** Sprays, Atomization, Droplet Size Distribution, Artificial Intelligence, Convolutional Neural Networks, Machine Learning