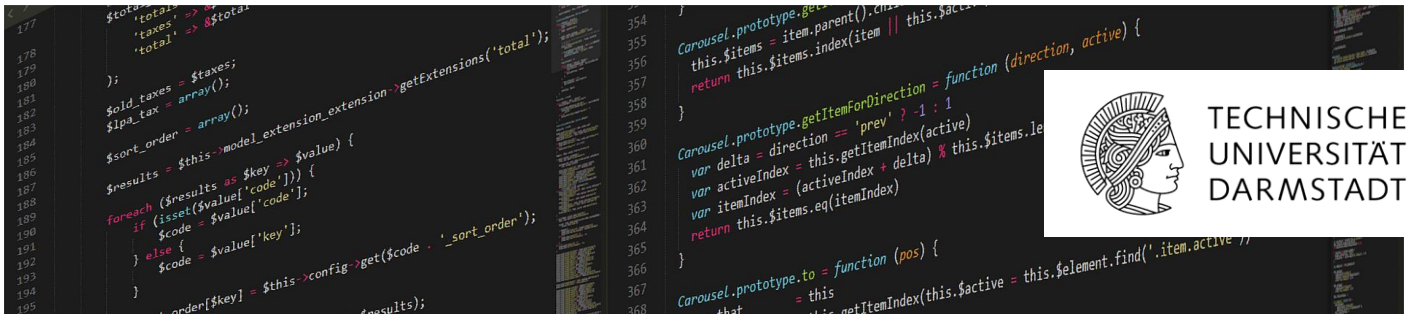

TECHNISCHE UNIVERSITÄT DARMSTADT

Master/Bachelor Thesis

Development and Testing of a Machine Learning-based Flame Binarization Technique

Entwicklung und Test einer auf maschinellem Lernen basierenden Flammenbinarisierung

Motivation:

The early flame kernel development in modern spark-ignition engines is crucial in determining the efficiency and emissions involved in their operation. An extensive database of early flame images has been acquired by using high-speed planar Mie scattering (from particle image velocimetry) to record the evaporation of seeded oil droplets in an optically accessible single cylinder research engine. To analyze the flame development, the raw images must first be binarized (such that the flame is separated from the particle images).

Objectives:

Despite the availability of advanced digital image processing algorithms, it remains a challenge to accurately binarize experimentally-obtained flame data due to a number of factors such as inhomogeneous lighting, reflections, and noise. The figure to the right shows an example raw image and overlain contours of a flame propagating adjacent to the spark plug. Even though the flame is easily recognizable to the human eye, it is difficult to algorithmically separate the flame from the surrounding features. Therefore, the goal is to use machine learning (ML) techniques such as DeepOtsu (https://doi.org/10.1016/j.patcog.2019.01.025) or convolutional neural networks, to achieve a more efficient and accurate universal model for flame binarization.

Responsibilities:

- Familiarization with digital image processing and ML-based image binarization methods
- Develop a flame binarization technique using traditional digital image processing algorithms as the baseline set
- Select one or more ML-based techniques and develop a model to exceed the performance of the traditional binarization method
- Interpretation of the results of both techniques, hold intermediate and final presentations, and write final Thesis

Requirements:

- Self-driven and motivated to independently explore complex topics
- Strong ability to code with MATLAB and/or Python
- Experience in machine learning
- Interest in data/image processing
- Basic knowledge of laser diagnostics and combustion
- Comfortable working in English (English or German Thesis is possible)

Interested? Feel free to contact me!

Start date: Upon arrangement

Reaktive Strömungen und Messtechnik (RSM)

Reactive Flows and Diagnostics

RSM Reaktive Strömungen + Messtechnik

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