

Dissertation title:

Hardware-efficient algorithms for imaging real-time measurement of particle-based flows using the example of thermal spraying processes

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Abstract

The results of manufacturing processes that are based on particle flows depend on the velocities and distribution of those particles inside the flow. Subjects of this thesis are hardware-efficient algorithms for the real-time image-based measurement of particle velocities. The algorithms are based on Particle Image Velocimetry techniques, which have a high tolerance against various sources of error such as overlaid particle projections and noise. In order to evaluate the accuracy of the measurement algorithms, distinctive particle characteristics and the physical processes during image capturing have been modeled and a software tool for generating particle images was implemented. The generated images serve as a basis for the measurement algorithms to evaluate the results of those algorithms for arbitrary, modeled particle distributions by using virtual measurements.

Within the scope of this thesis, measurement algorithms and a smart camera for determining particle velocities were proposed and combined to an imaging measurement system. A substantial property of this imaging system is the real-time availability of measurement data due to the proposed hardware-efficient measurement algorithms. A demonstrator was successfully implemented and applied to real-time measurements of particle velocities on thermal spray processes.