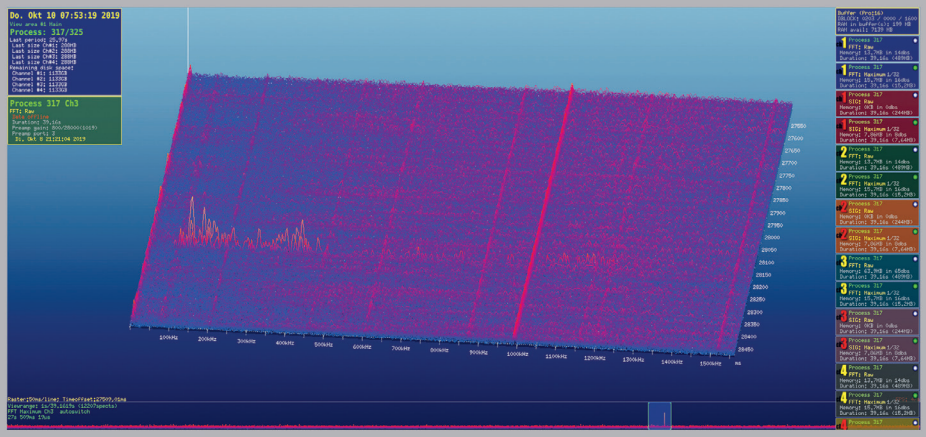

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LPBF PROCESS MONITORING USING ULTRASOUND

Task

As part of the Fraunhofer lighthouse project futureAM, acoustic sensors are being used to monitor the laser powder bed fusion (LPBF) process. The project aims to detect typical defects in LPBF early and reliably, such as cracks and delaminations. Three piezo sensors and a laser microphone are used for detection. Airborne and structure-borne sound is detected up to the MHz range. During the first experiments, it became apparent that the clear assignment of the ultrasonic signals to process events posed a challenge.

Method

An LPBF machine was converted so that the three piezo sensors could be attached to the underside of the substrate plate. The laser microphone for airborne sound measurement was installed in the process chamber. The sound waves emitted by the process are detected by the four sensors and subjected to a Fourier transformation. The time and frequency signals thus obtained are analyzed with respect to relevant statistical features. So that the ultrasonic signals can be assigned to process defects and events, the signals are induced in a targeted manner and recorded by additional sensors such as a laser power meter, pyrometer and thermographic camera.

Results

The experiments and data analyses have shown that the process events and defects examined have unique signal characteristics that can be assigned to a specific event or defect. Cracks, delaminations, and overhang exposures can now be clearly detected in the LPBF process thanks to the piezo sensors and the laser microphone.

Applications

In this research project, the sensor design has already been successfully applied to LPBF to detect component defects at an early stage. In addition, this setup can also be used for other laser material processing methods such as laser beam welding or laser material deposition (LMD). The advantage is that the sensors can be easily integrated into industrial laser processing machines and also easily retrofitted into existing systems.

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1 Detection of a process deviation.