Using High-Speed Imaging and Machine Learning to Capture Ultrasonic Treatment Cavitation Area at Different Amplitudes with respect to Time

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The ultrasonic treatment process strengthens metals by increasing nucleation and decreasing grain size in an energy efficient way, without having to add anything to the material. The goal of this research endeavor was to use machine learning to automatically measure cavitation area in the Ultrasonic Treatment process to understand how amplitude influences cavitation area. For this experiment, a probe was placed into a container filled with turpentine because it has a similar viscosity to liquid aluminum. The probe gyrates up and down tens of micrometers at a frequency of 20 kHz, which causes cavitations to form in the turpentine. Each experimental trial ran for 5 seconds. We took footage on a high-speed camera running the UST probe from 20% to 35% amplitude in increments of 1%. Our research examined how the amplitude of the probe changed the cavitation area per unit time. It was vital to get a great contrast between the cavitations and the turpentine so that we could train a machine learning model to measure the cavitation area in a software called Dragonfly. We observed that as amplitude increased, average cavitation area also increased. Plotting cavitation area versus time shows that the cavitation area for a given amplitude increases and decreases in a wave-like pattern as time passes.