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An Integrated Setup for Sequential Hybrid Laser Beam Micromachining (LBMM) and Micro-EDM for Machining Micro-hole Arrays with Automated Tool Localization

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Abstract

Micro holes array has significant applications in the field of aerospace and turbo machinery, industrial filtration, microfluidic devices, biomedical engineering, and so on. There are various ways to manufacture micro holes arrays. In order to have a cost-effective, yet precise and efficient process for the fabrication of micro holes array, an integrated setup has been introduced in this paper to combine Laser Beam Micro Machining (LBMM) and micro-EDM (µEDM). This approach uses LBMM for quick material removal and µEDM for precise finishing. However, one of the main challenges in hybrid LBMM-µEDM is the localization of LBMM micro holes for accurate positioning of µEDM electrode. In this present study, an integrated setup with automated hole localization has been presented to improve the hybrid LBMM-µEDM process in terms of alignment accuracy and machining rate. The microscope camera that is mounted on the µEDM stage scans and captures images of LBMM holes. Then, the images were stitched and processed using image processing techniques to get the center coordinate of the LBMM micro holes. Finally, the operator validated the coordinates and G-code was automatically generated for the µEDM process to perform the fine finishing. The result indicated that the alignment accuracy is within 15 µm. Furthermore, the newly developed automation strategies for the hybrid LBMM-µEDM process show significant improvement in machining time with 5 × faster than the pure µEDM process, and better performances in overcut, taper angle, and electrode wear. Furthermore, the hybrid process was found to be 1.6 × more energy efficient as compared to the pure µEDM process. Overall, the newly developed integrated system was found to be highly effective for producing micro holes array.

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