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Auto-detection of focal position on a curved surface in laser micromachining

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A novel method for exploring the focal point of a curved surface offered numerous benefits both in fundamental and applied aspects. Conventional techniques of creating a spot on a workpiece, which includes specifying the smallest circular beam spot using naked eye and extra laser, have significant limitations. Here a unique technique for determining the focal point of a curved surface using an optical setup with a charge-coupled device (CCD) camera to identify the profile of a laser beam. The method is multifunctional as it utilizes a scanning process with a laser beam which is the investigation of changes in shape and diameter of the beam spot on CCD camera when the workpiece was moved and tilted around focal position. At the same time, an analytical model involving three-axis movement is proposed, and experimental systems are analyzed. Subsequently, the workpiece can be precisely positioned and the focal point can be identified based on the analysis of obtained results afterward. Furthermore, the proposed method is also capable of locating the focal point on any curved surface. Accordingly, the analytical model, data analysis, and focal spot positioning method would be integrated as the algorithm to construct a distinctive auto-focusing system on curved surface in the future. In addition, it is also able to fabricate microgrooves on curved surfaces by laser ablation and conduct dry lithography of roll surfaces in printed electronics.