

Development of high-speed polygon-galvanometer scanning system supporting Micro-LED massive transfer

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Abstract

Compared with LCD and OLED, Micro-LED has the advantages of longer lifespan, lower power consumption, faster response, and larger view angle. Hence it is well-recognized as the most promising technology of the next generation display. In order to manufacture large-scale Micro-LED displays in a high speed and high precision manner, massive transfer is an enabling technique for the process of transferring tens or even hundreds of million Micro-LED units from the original substrates to the display target substrates. The transfer speed is essential to the massive transfer process. And among the existing massive transfer techniques, laser-induced forward transfer is of the highest speed. To further increase the transfer speed, a polygon-galvanometer based scanning system is proposed due to the high speed, large aperture and high throughput of polygon mirror. The theoretical transfer rate is of 1000M units/hr, which is way faster than the existing solutions.

To optimize scanning performances, the laser path of the scanning system is taken into account. Based on the geometrical relationship between incident laser and laser spot on processing plane, major parameters affecting the laser path are analyzed. Selective laser-assisted forward transfer demands system's ability of processing high-speed data and sending synchronized commands, so a high-speed parallel control system is designed based on FPGA. The combinatorial logic of the FPGA is utilized to processing pulses from the sensor. Based on the 5ns clock cycle of FPGA, laser and galvanometer commands are synchronized with the real-time angle of the polygon. The experimental result validates the high-speed scanning capability of the proposed scanning system. Further, a dot array scanning experimental result shows that the spacing error is less than 7 μm (RMS) with the linear velocity of 62 m/s.

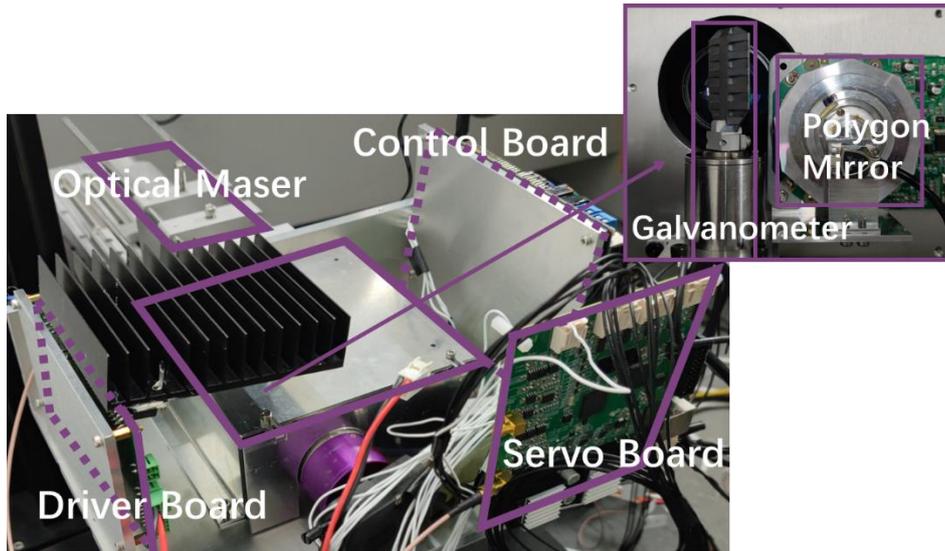


Figure 1: The high-speed polygon-galvanometer scanning system

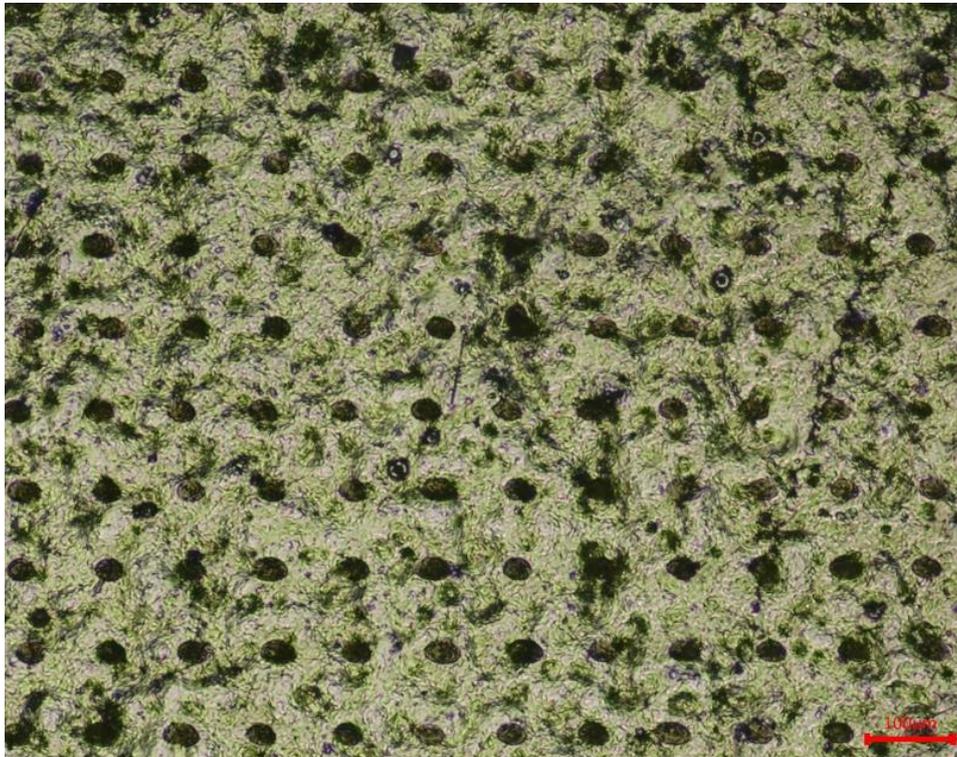


Figure 2: Array of points with 100µm space at scanning speed of 31 m/s