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Development and characterization of a resonant scanner based 2-photon polymerization printer

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2-Photon Polymerization (2PP) is a 3D printing method that enables the creation of features in the sub-micrometer range. While high resolution is the technology's main advantage, it also results in a significant drawback, namely the low throughput of 2PP systems. In recent years, significant advancements in this regard were made, mainly by using galvanometer scanners instead of linear translation stages for beam positioning. With such scanners, printing velocities in the range of 1 m/s are possible. Achieving even higher speeds is possible by operating one of the scanners at its resonance frequency. The continuous movement of such a resonant scanner means that it is not possible to control the position and velocity of the scan mirror directly. Therefore, when using a resonant scanner, a particular emphasis has to be put on fully characterizing the system to be able to tailor the control signals accordingly.

We built a 2PP setup optimized for the advantages of a resonant scanner and developed test routines to characterize the system. A position-sensitive detector was used to record both the resonant and the regular galvo scanners' movement patterns. Subsequently, position scaling and laser power were corrected accordingly. This enables us to print structures with a maximum scan velocity of 66 m/s while maintaining high spatial resolution.