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Optimization of High-NA Structured Light Generators via Rigorous Coupled-Wave Analysis

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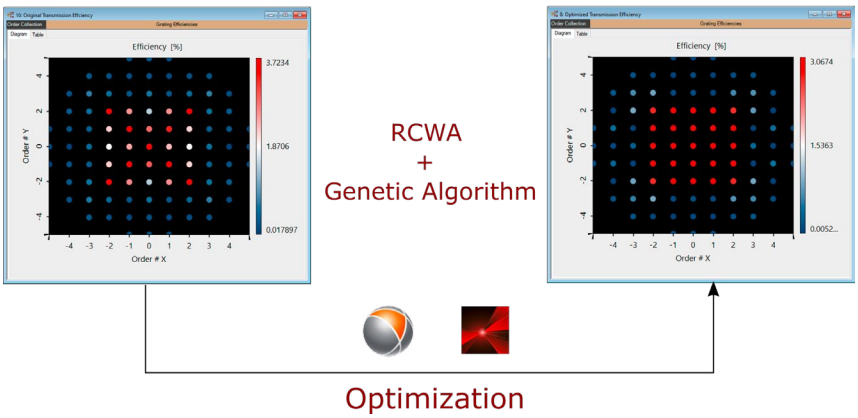
In this work, a systematic set of steps is proposed to overcome the structure design obstacle for high-NA structured light generators (SLG). The entire procedure essentially breaks down into two parts:
initial design and structure manipulation. As the first step, the iterative Fourier transform algorithm (IFTA) is employed and a well-behaved phase distribution is obtained. Proceeding to that, based on the designed phase, a transmission function is constructed. Subsequently, as a transition from the function embodiment to the structure embodiment, the thin element approximation (TEA) is utilized. However, TEA is not valid for structures whose feature sizes are comparable to the incoming beam's wavelength. Therefore, it leaves one no choice but to modify the shape of the structure using optimization. In each cycle, the structure is evaluated with the rigorous coupled-wave analysis(RCWA) and is fed back to the optimizer iteratively.
As to structure manipulation, two parameterization techniques are proposed. In the first one, the structure is chopped up into binary layers, and to each layer, a scaling coefficient is applied. In the second technique, each binary layer's shape is manipulated using the B-spline control points. After doing so, the structure is subject to manipulation using the genetic algorithm (GA) and is then evaluated by RCWA per optimization cycle. After optimization, the uniformity error dropped significantly and there was also a slight increment in the diffraction efficiency.



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