Topology optimization for optical microlithography with partially coherent illumination

This article revisits a topology optimization design approach for micro-manufacturing and extends it to optical microlithography with partially coherent illumination. The solution is based on a combination of two technologies, the topology optimization and the proximity error correction in microlithography/nanolithography. The key steps include (i) modeling the physical inputs of the fabrication process, including the ultraviolet light illumination source and the mask, as the design variables in optimization and (ii) applying physical filtering and heaviside projection for topology optimization, which corresponds to the aerial image formulation and the pattern development processes, respectively. The proposed approach results in an effective source and a binary design mask, which can be sent directly to fabrication without additional post-processing steps for proximity error correction. Meanwhile, the performance of the device is optimized and robust with respect to process variations, such as dose/photo-resist variations and lens defocus. A compliant micro-gripper design example is considered to demonstrate the applicability of this approach.