Solving the Inverse Problem in Photo-Lithography

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As we print circuits substantially smaller than the lithographic wavelength, a new kind of lithographic philosophy presented itself. Ordinary masks are a direct photographic representation of the desired circuit patterns. With phase masks, for example, the mask patterns do not necessarily have a direct match to the desired circuit image. As the sophistication of mask design grows, and as the additional design degrees of freedom are employed, lithographic masks will look more and more like holograms. They will appear very complex, and it will not be possible to discern the desired image directly in the mask. Nevertheless they will print high resolution circuit patterns, correctly and robustly, as desired.

Our task then is to find a systematic methodology to solve the inverse problem, and to design the lithographic masks. Fortunately there has recently been great progress in mathematical techniques and image processing algorithms for doing this. There will be a bigger and bigger role for software and mathematics to make it possible to create nano-devices and nano-circuits in the Nano-World.