TUTORIAL PROPOSAL

Tutorial Title:	**Metalens Design: a Complete Workflow using Ansys Lumerical and Ansys Zemax OpticStudio**
Presenters:	**Nikhil Dhingra / Senior Application Engineer / Ansys**
	Udit Kumar / Application Engineer II / Ansys
Tutorial duration:	**1.5 hours**

MOTIVATION / NEED ANALYSIS

Flat optics is emerging at a rapid rate and has a potential to replace the bulk optics in various application domains. The implementation of flat optics using diffractive optics is well established and has been there for years. Another emerging implementation called metasurface optics provides higher imaging performance and produces substantially less stray light than the diffractive optics. Metalenses use planar surfaces consisting of sub-wavelength structures called “nanopillars” to manipulate light and provide a degree of control not possible with traditional refractive lenses. These structures provide complete control over the intensity, phase, and polarization of light.

Designing metalenses for practical applications require both electromagnetic field simulations of wavelength-scale structures and ray tracing simulations for the optimization of the lens system. This requires a well-established workflow and tools for ensuring the accuracy and efficiency of the design process. Ansys provides the gold standard electromagnetic field solvers as part of Ansys Lumerical and ray tracing tools as part of Ansys Zemax OpticStudio. In addition, we have seamless workflow for the designing of metalens using interoperability between Lumerical and Zemax. Hence, this tutorial would be beneficial for student to learn about the industry standard optical simulation tools and how these tools can be utilized in the designing of complex metasurfaces.

DESCRIPTION

Metalenses consist of carefully arranged "unit cells" or "meta-atoms" with sub-wavelength structures. By adjusting the geometry of these unit cell elements, one can modify the phase above the elements in response to a plane wave. With the knowledge of the phase in terms of the geometry parameters, it is possible to create a metalens with an arbitrary phase profile by placing the meta-atoms at the necessary positions. This allows the metalens to provide the desired functionality while taking advantage of the flat optics.

The tutorial starts with an introduction to optics and photonics and explains the interaction of light at different scales (nano to macro). Next, it provides a basic introduction to the applications of flat optics with an emphasis on the metalens. Then it takes you through the step-by-step process of designing a metalens using industry leading tools offered by Ansys.

INTENDED AUDIENCE

Students, researchers, or engineers who are interested in learning about the end-to-end design cycle of the metalens.

OUTLINE / AGENDA OF THE TUTORIAL

- Introduction to Optics & Photonics (≈ 10 minutes)
  - End to end optical simulation: from nano-to-macro
- Introduction to flat optics (≈ 10 minutes)
  - Metalens and its applications
- Design of a metalens: a step-by-step tutorial (≈ 60 minutes)
  - Target phase profile
  - Unit cell simulation
  - Full lens design and nearfield export
  - Propagation of imported beam in OpticStudio
  - GDS export
- Feedback and Q&A session (≈ 10 minutes)

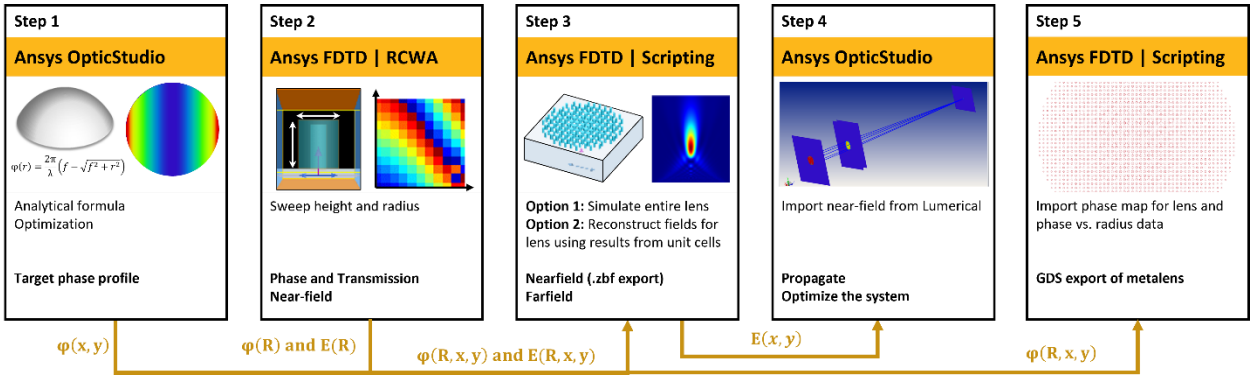

Fig 1. Simulation Workflow

LEARNING OUTCOMES

The tutorial will enable the attendees to understand:

- Interaction of light at different scales
- Difference between bulk optics and metasurfaces
- How metalens are designed?
- Optical simulations: from nanoscale to macroscale

REFRENCES

https://optics.ansys.com/hc/en-us

https://metalenz.com/what-are-meta-optics/