

Photonic Crystal Fiber

Products: FemSIM FEM, MOST

Applications: Photonic Crystals

Introduction

One critical part of the design cycle is understanding the parameter space of a device. This not only ensures that an optimal device is fabricated, but also helps understand the effect of fabrication tolerances on device performance. **RSOFT MOST** provides powerful scanning and optimization tools to explore a device's parameter space and help designers create optimal designs. The **RSOFT CAD** is a parametric design environment that allows any structural parameter, either geometric or material, to be defined via a variable; these variables can be scanned or optimized in MOST.

Here are some tips to help you get the most out of MOST:

Tips 1: Use Post-Processing and Resume

MOST's post processing feature allows you to recalculate the scan plots without re-calculating the simulation results. This allows you to quickly experiment with different plotting options, variable reordering, user measurements, and metrics without having to rerun the scan. The resume feature lets you resume a scan which was previously interrupted or stopped by the user.

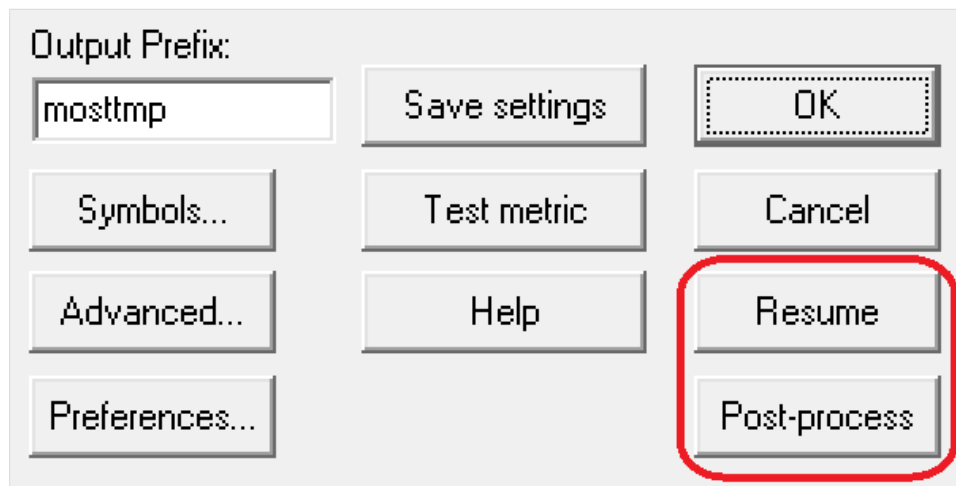


Figure 1. The Post-process, Resume, and Preferences buttons in the MOST dialog box.

Tips 2: User Metrics

User metrics are the scalar target of an optimization in MOST, but can be used for custom post-processing of scan output for parameter scans. As an example, consider the calculation of the birefringence vs. wavelength of a Photonic Crystal Fiber (PCF).

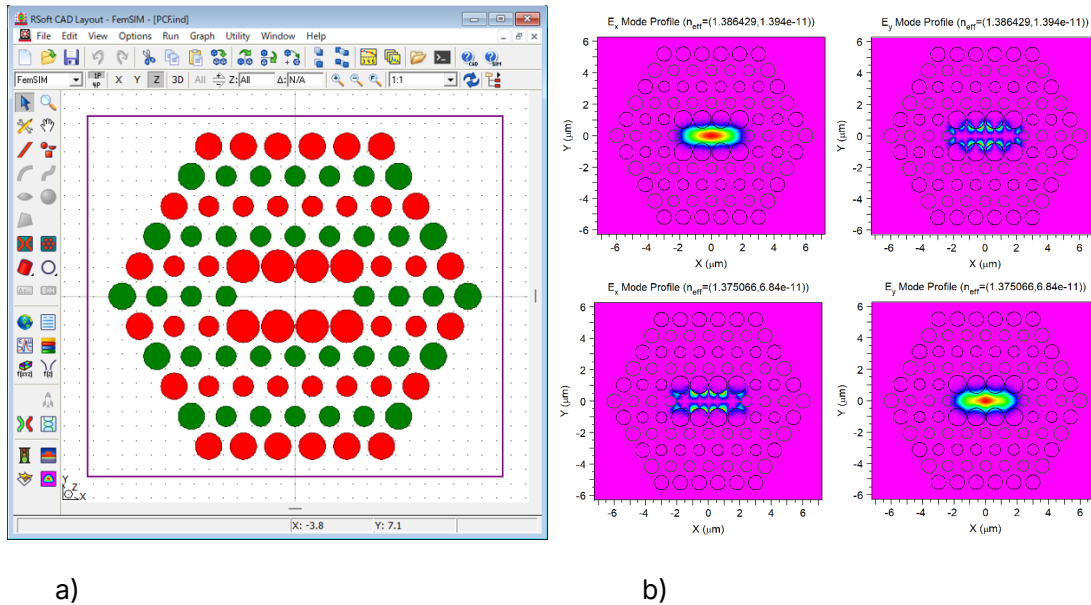


Figure 2. a) PCF geometry in the RSoft CAD, b) computed TE (top) and TM (bottom) modes for a single wavelength.

The birefringence is the difference between the effective indices of the TE and TM modes. Since **FemSIM FEM** solves for modes of both polarizations at once, we can calculate both effective indices (which are the built-in MOST measurements `fs_mode_neffr_0` and `fs_mode_neffr_1`) from a single simulation. However, it is not immediately clear how to calculate the birefringence without manually post-processing after the scan.

User Metrics make this task simple. Move to the **Metrics** tab in the MOST dialog box and click **Add**. Set the **Name**, choose a **Type** of Expression, and set the **Expression** to `fs_mode_neffr_0-fs_mode_neffr_1`. This expression is built using the built-in measurements defined on the **Measurements** tab.

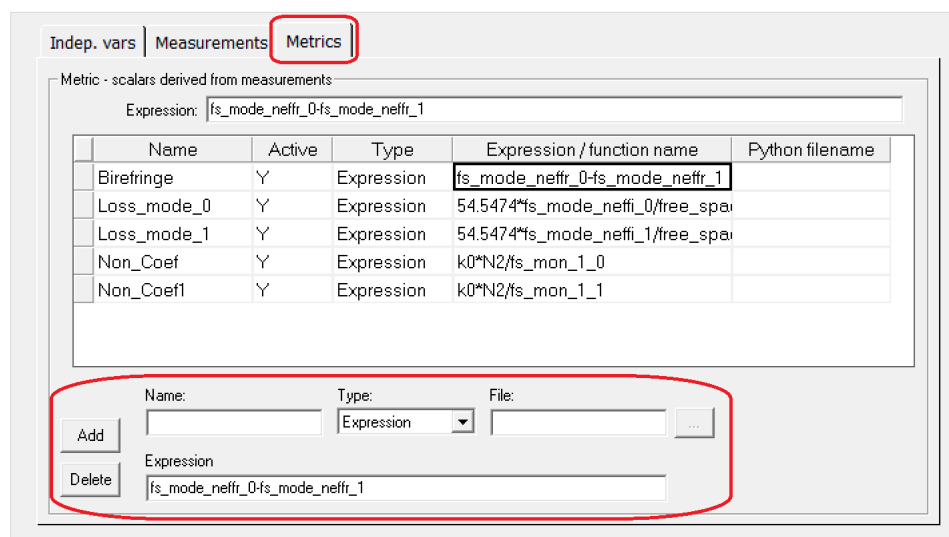


Figure 3. The Metrics tab in the MOST dialog box where User Metrics are defined.

Running a parameter scan over wavelength gives the desired plot of birefringence vs. wavelength:

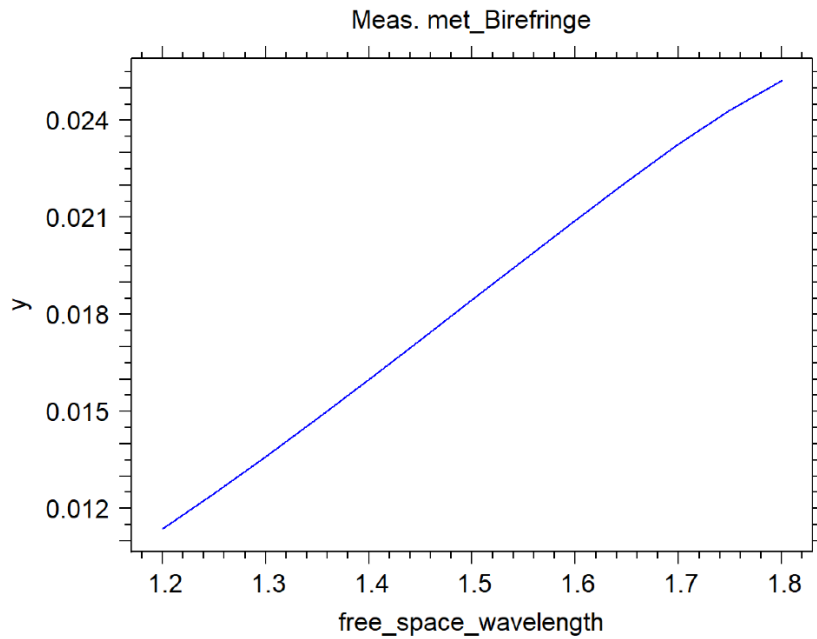


Figure 4. Calculated birefringence

The scanning portion of MOST is included with every **RSoft device simulation tool (FullWAVE FDTD, BeamPROP BPM, DiffractMOD RCWA, etc.)**; the optimization and distributed scan (clustering) portions are licensed separately.

Conclusion

In this application note, we demonstrated how MOST User Metrics can be used to automate the extraction of derived performance parameters from simulation results. Using a photonic crystal fiber example, birefringence was calculated directly from the effective indices of the TE and TM modes and evaluated as a function of wavelength through a parameter sweep. Combined with MOST's Post-Processing and Resume capabilities, User Metrics provide an efficient workflow for analyzing simulation data, reducing manual post-processing, and accelerating photonic device design studies.

Example files

Download the full application note and simulation files for RSoft Application Note:
Supporting Files for Application Note: "Photonic crystal fiber"

References

[1] H. Ademgil, S. Haxha, and F. AbdelMalek, "Highly Nonlinear Bending-Insensitive Birefringent Photonic Crystal Fibres," *Engineering*, Vol. 2, pp. 608-616 (2010).

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