# Results

We compared the first five modes of simulation result with the theory result [1] as below:

For all TE modes, we compare the dashed line (magnetic field line) in theory with our result plot of Hz. For all TM modes, we compare the solid line (electric field line) in theory with our result plot of Ez.

Rectangular waveguide:

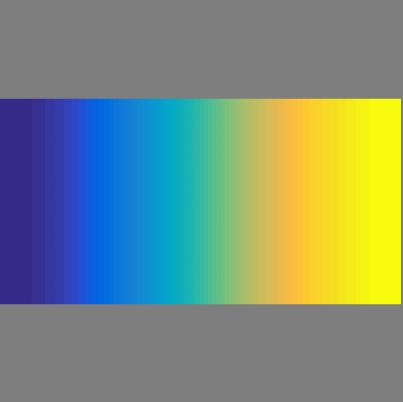
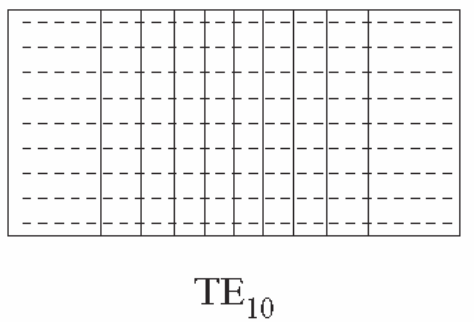


Figure 1. TE10

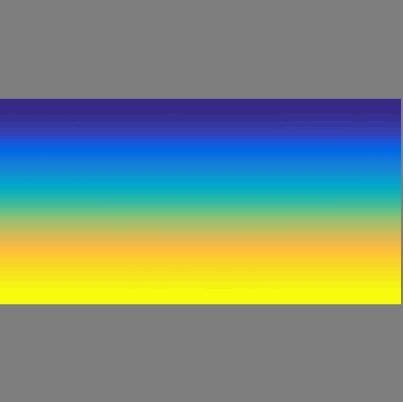
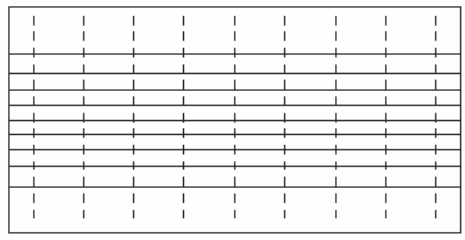


Figure 2. TE01

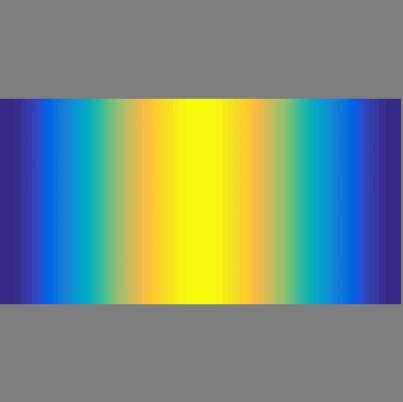
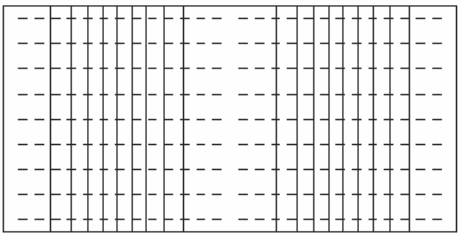


Figure 3. TE20

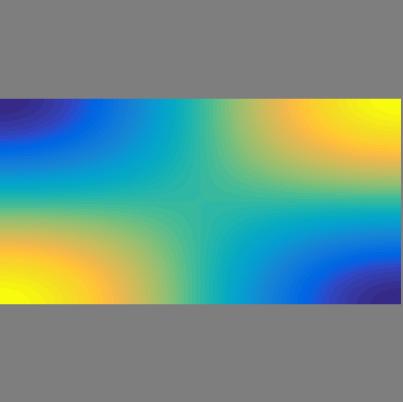
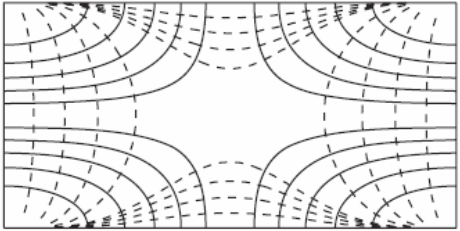


Figure 4. TE11

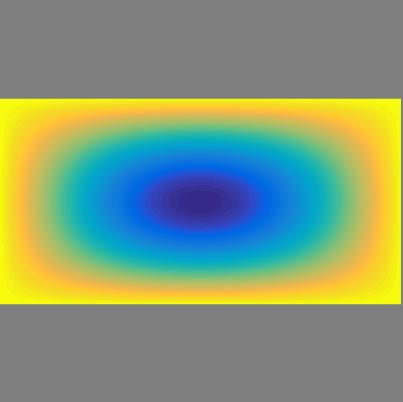
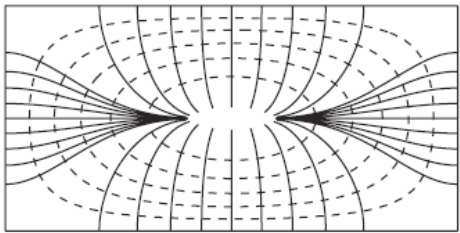


Figure 5. TM11

Circular Waveguide:

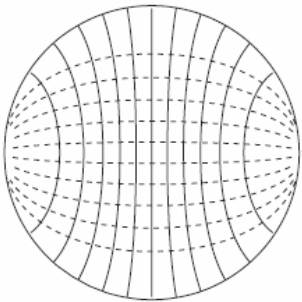


Figure 6. TE11

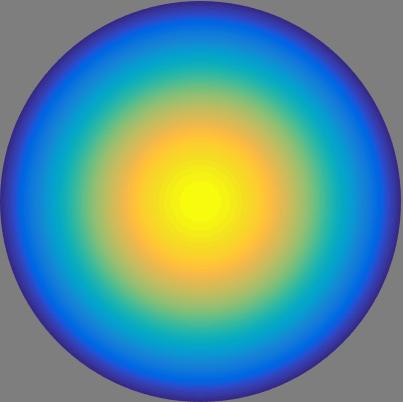
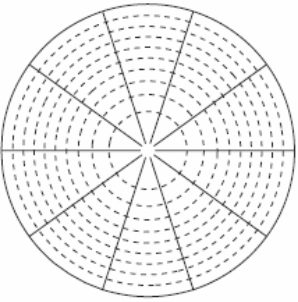


Figure 7. TM01

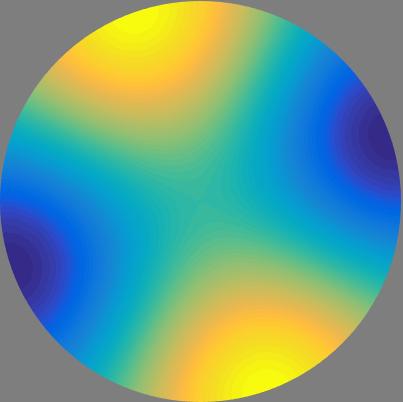
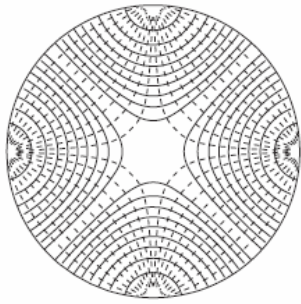


Figure 8. TE21

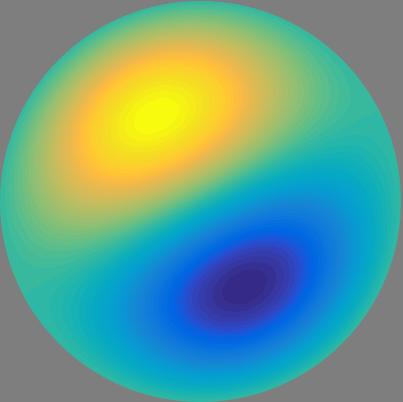
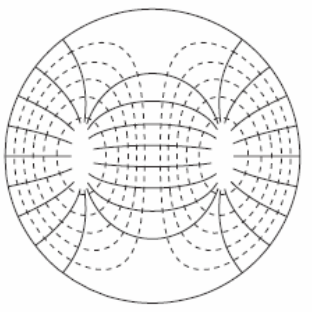


Figure 9. TM11

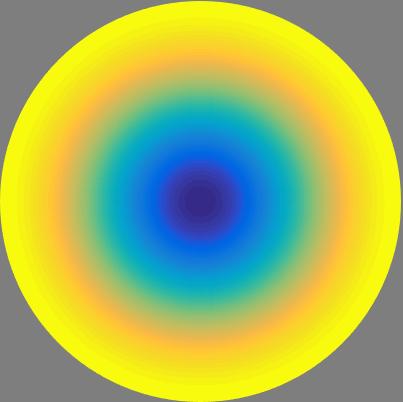
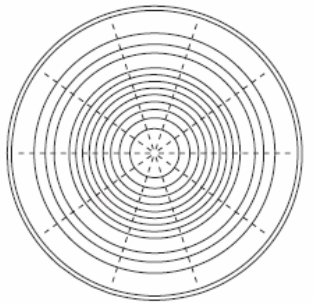


Figure 10. TE01

We also compared  of the first 20 modes with theory result as below:

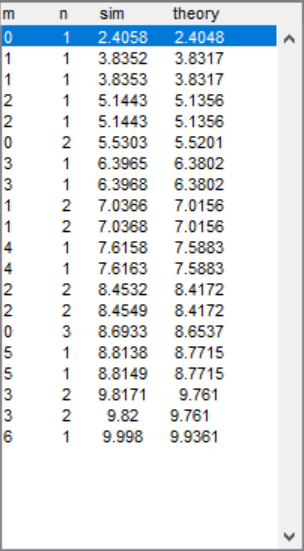
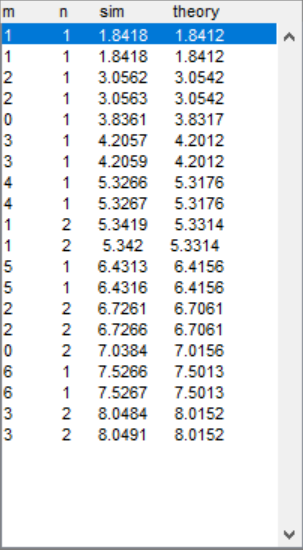
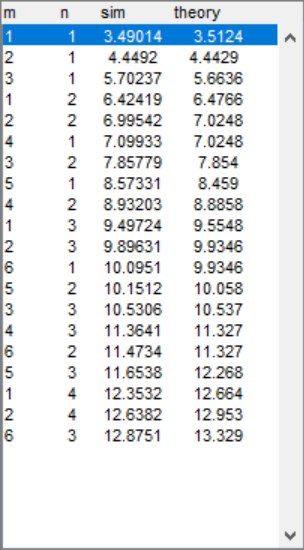
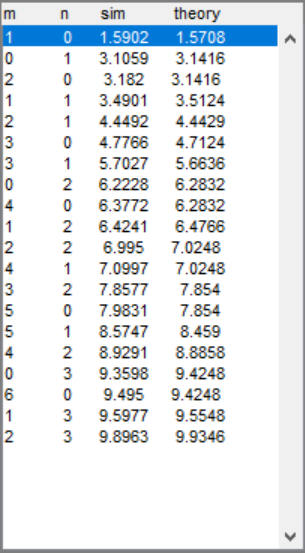


Figure 11. Rectangular TE Figure 12. Rectangular TM Figure 13. Circular TE Figure 14. Circular TM

From the result figures and , the simulation matches the theory.

# References

[1] Jian-Ming Jin. *Theory and Computation of Electromagnetic Fields*. Wiley-IEEE Press, 2015