Modeling of Bessel Beam Generation from Axicon with Round Tip
Bessel beams, due to their non-diffracting property, are drawing attentions for different applications. They are typically generated from axicons. An ideal axicon with infinite tip does not exist, and, in practice, an axicon comes with a rounded tip. In this example, we investigate the effect of the round tip on the generated Bessel beams, following the research work in [O. Brzobohatý, et al., Opt. Express 16, 12688-12700 (2008)]. Particularly, we simulate beam evolution along z and compare the results.
Modeling Task

- input field
  - fundamental Gaussian
  - wavelength 1064 nm
  - waist radius 2140 µm

- round-tip axicon
  - refractive index $n=1.50669$
  - apex angle $\tau=170^\circ$
  - round-tip parameter $a=10, 30, 60 \mu m$
  - modeled as a transmission function

How does the generated Bessel beam evolve along $z$, especially with respect to different round tips?

$$h(\rho) = -\sqrt{a^2 + \frac{\rho^2}{\tan^2(\tau/2)}}$$
Bessel Beam at a Fixed Z-Position

- A round-tip axicon with:
  - $n = 1.50669$
  - Apex angle $\tau = 170^\circ$
  - $a = 10, 30, 60\,\mu m$

- Diagram showing the Bessel beam at a fixed Z-position with various data sets for different wavelengths.
Bessel Beam Evolution Along Z (a=10µm)

round-tip axicon
- \( n = 1.50669 \)
- apex angle \( \tau = 170^\circ \)
- \( a = 10\mu m \)
Bessel Beam Evolution Along Z ($a=10\mu m$)

- round-tip axicon
  - $n=1.50669$
  - apex angle $\tau = 170^\circ$
  - $a=10\mu m$
Bessel Beam Evolution Along Z (a=30µm)

- round-tip axicon
  - \( n = 1.50669 \)
  - apex angle \( \tau = 170^\circ \)
  - \( a = 30 \mu m \)
Bessel Beam Evolution Along Z ($a=30\mu m$)

- round-tip axicon
  - $n=1.50669$
  - apex angle $\tau=170^\circ$
  - $a=30\mu m$
Bessel Beam Evolution Along Z (a=60µm)

- $n=1.50669$
- Apex angle $\tau = 170^\circ$
- $a=60\mu m$

Data for Wavelength of 1.064 µm [1E3 (V/m)^2]
Bessel Beam Evolution Along Z (a=60µm)

round-tip axicon
- $n=1.50669$
- apex angle $\tau=170^\circ$
- $a=60\mu$m

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On-Axis Distribution and Comparison

simulation result in VirtualLab Fusion

Fig. 2 from O. Brzobohatý, et al., Opt. Express 16, 12688-12700 (2008)
Peek into VirtualLab Fusion

customizable and flexible transmission definition

field visualization and analysis

parameter sweep
Workflow in VirtualLab Fusion

• Set up input Gaussian field
  – Basic Source Models [Tutorial Video]

• Set the position and orientation of components
  – How to Work with the Programmable Function & Example (Cylindrical Lens) [Use Case]

• Sweep the parameters and check the influence
  – Usage of the Parameter Run Document [Use Case]
VirtualLab Fusion Technologies
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