A Wave Optics Based Fiber Scattering Model

Presenter:

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Introduction:

Existing fiber scattering models in rendering are all based on tracing rays through fiber geometry, but for small fibers diffraction and interference are non-negligible, so relying on ray optics can result in appearance errors. We present the first wave optics based fiber scattering model that comes from a full wave simulation.

Contributions:

1. A Boundary Element Method (BEM) based simulator.

Solving Maxwell's equations for a straight fiber of constant cross section illuminated by a plane wave reduces to solving for a 3D electromagnetic field in a 2D domain. From the resulting fields we compute far-field scattering distributions, which we use to simulate scattering by fibers in a path tracer.

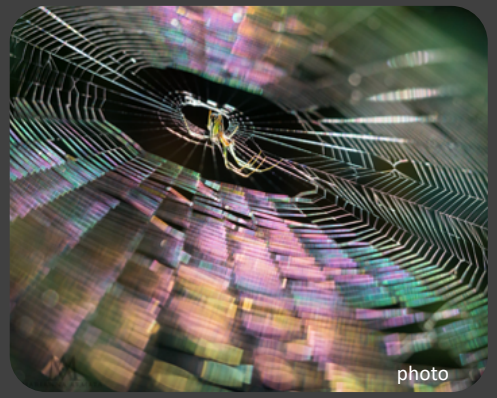
2. Integrate the wave optics fiber scattering model into a modern rendering system.

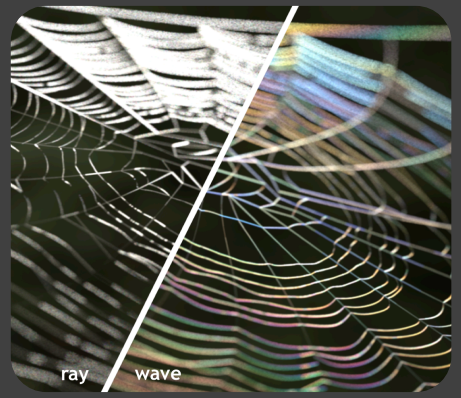
Our approach can reproduce a wide range of fibers with different sizes, cross sections, and material properties, including textile fibers, animal fur, and human hair.

3. Examine the similarities and differences between ray and wave optics predictions.

Textured fur

We present the first wave optics fiber scattering model in Computer Graphics. Compared to previous ray models, our method produces **strong color effects**, **strong forward scattering peak**, and **softening of sharp features**.





Take a picture
and visit the project page
mandyxmq.github.io/research/wavefiber.html

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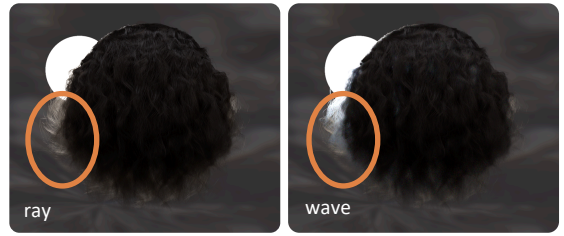
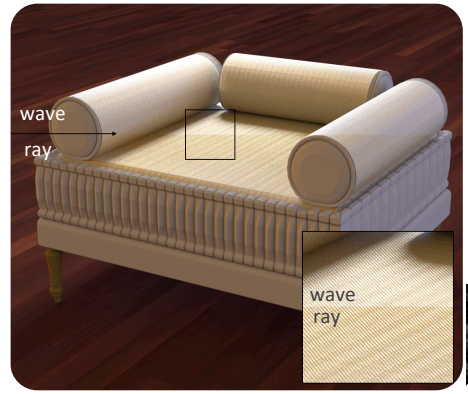
Results:

1. Strong forward scattering.

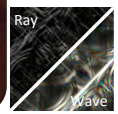


2. Different highlight shape.

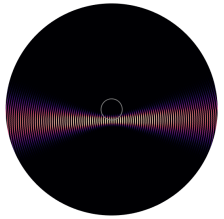


Silk fiber cross section

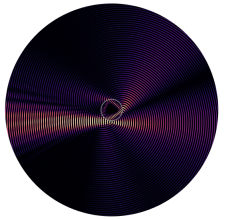
Azimuthal scattering function



3. Wave incident on a fiber cross section.



incident fields



total fields

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