



# ScatterBrain Documentation

Version 1.0

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This software calculates the relative light intensity in a 3D turbid medium, illuminated from the surface by an optical fiber.

The software implements a modified Beam Spread Function (BSF) analytical model, as explained in [Yona \*et al.\* "Realistic Numerical and Analytical Modeling of Light Scattering in Brain Tissue for Optogenetic Applications," eNeuro, Jan 2016, 3\(1\).](#)

## Running the simulation

1. Run ScatterBrain.m
2. Enter the optical fiber geometric parameters: radius (in  $\mu\text{m}$ ) and NA. Change any of the optical coefficients as needed.
3. Enter a Point of Interest (POI; in  $\mu\text{m}$ , enter at  $5\mu\text{m}$  resolution), at which the light intensity will be displayed. X and Y axes are the horizontal axes, and Z is the vertical axis.  
Note: the X or Y components of the POI determine the plane of the displayed cross-section (the default is the Y component).
4. Press 'Run'.
5. The program may take several minutes to run, according to the settings. The logarithmic intensity map in a cross-section will be shown, with the overlaid POI as a red circle. The relative light intensity at the POI is displayed at the bottom. A colorbar can be displayed by pressing 'Toggle colorbar'.

The program outputs two files to the current folder of MATLAB:

out.mat: a 3D matrix containing the light distribution in the calculated volume. The resolution of the matrix is  $5\mu\text{m}$ .

out\_z.mat: a vector containing the light intensity along the z-axis (the vertical axis centered at the fiber center).

### Settings

**Angular resolution:** the number of discrete angular divisions of the numerical aperture used to calculate the angular convolution. Typical values are 8-64. Greater values would slow the calculation, while lower would lower the accuracy.

**dt [fs]:** the time-step of the BSF calculation before integration over time. Default is 5 fs.

**max t:** the maximal time limit of the BSF time integration, given in multiples of  $\sigma^2/\mu$  of the time dispersion of the scattered photons. Default value is 5.

**Cross section in y/x:** determines if the cross-section is displayed at the X or Y component of the POI.

**Please report any bugs to Guy Yona, email: [guy.yona@ndcn.ox.ac.uk](mailto:guy.yona@ndcn.ox.ac.uk)**