



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\(1\).](#)

Installation requirements

The software is a MATLAB application, tested under MATLAB version R2015b 64bit. To install, select the "install app" icon from the "Apps" tab in MATLAB, and open the installation file. The software should be successfully installed regardless of an error message that may be displayed.

Running the simulation

1. Press on the "ScatterBrain" icon in the "apps" tab. The icon appears in "My apps" section if scrolled down.
2. Enter the optical fiber geometric parameters: radius (in μm) and NA. Change any of the optical coefficients as needed.
3. Enter a Point of Interest (POI; in μm , 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 μm .

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 multiplications of σ^2/μ of the time dispersion of the scattered photons. Default 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