Evaluate accuracy of the Microlith package.

3D image of a point under fluorescent microscope with aberrations. Written by Shalin Mehta, www.mshalin.com, License: GPL v3 or later.

Contents

Set-up simulation grid:

```
% All quantities are expressed in normalized optical coordinates
% One can obtain the physical spatial coordinates like this:
% x (physical)= x (optical) * (wavelength/NA).
% In normalized coordinates, the jinc function's first zero occurs at 0.61
% and the circular pupil cuts-off at 1.

L=10; % Support over which we want to calculate the image.

xs=0.05; % Sampling rate in the specimen plane.
% To avoid aliasing, specimen should be sampled at 0.2 wavelength/NA
% atleast.
% Sampling rate in the specimen plane determines extent in frequency
% domain.  xs=0.1 should suffice as the transfer function fits into the square with
% side 2 or (1+S)/sqrt(2) and sampling at 0.1 defines support of [-5 5].

v=-L:xs:L; % Transeverse extent of simulation.
u=-2:2*xs:2; % Axial extent of simulation.
[vx, vy]=meshgrid(v);

% Point specimen.
specimen=double(vx==0 & vy==0);

% Some other specimens for which analytical image is easy to compute.
% % specimen=double(xx==0); %Slit
% % specimen=ones(size(xx)); %Transparent.
```

Case 1: 3D PSF without aberration.

```
clear params;
params.NAo=1;
params.wavelength=1;
params.nImm=1;
params.nEmbb=1;
RadioMetricFactor=params.NAo^2*(xs/0.1)^2;
% Factor that ensures radiometric consistency.

fluor=microlith(v,u);

computesys(fluor,'Fluorescence',params);
computeimage(fluor,specimen,'CPU');
```

Case 2: 3D PSF with astigmatism.

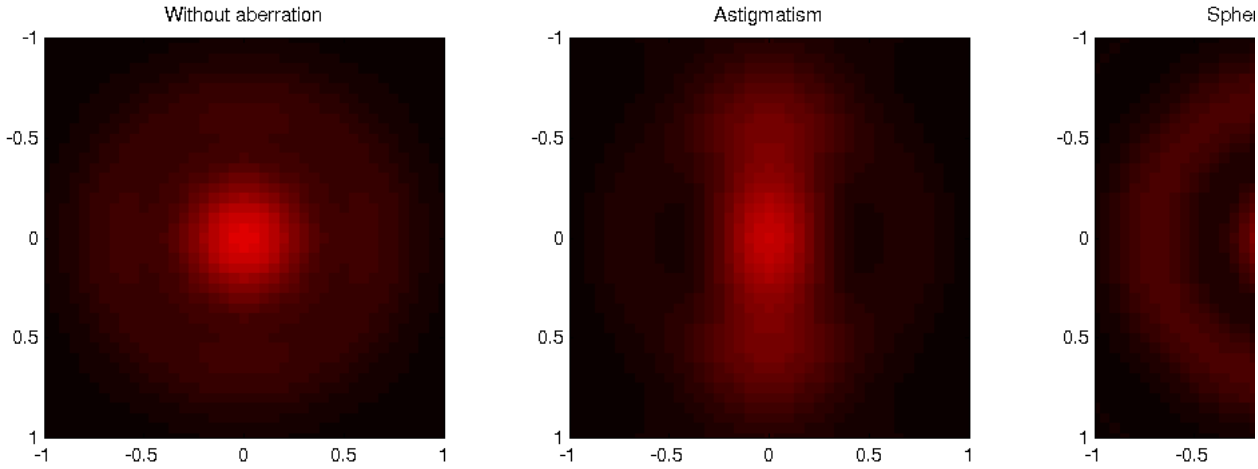
```
clear params;
params.NAo=1;
params.wavelength=1;
params.nImm=1;
params.nEmbb=1;
params.astigmatism=[1 0];

astig=microlith(v,u);

computesys(astig,'Fluorescence',params);
computeimage(astig,specimen,'CPU');
```

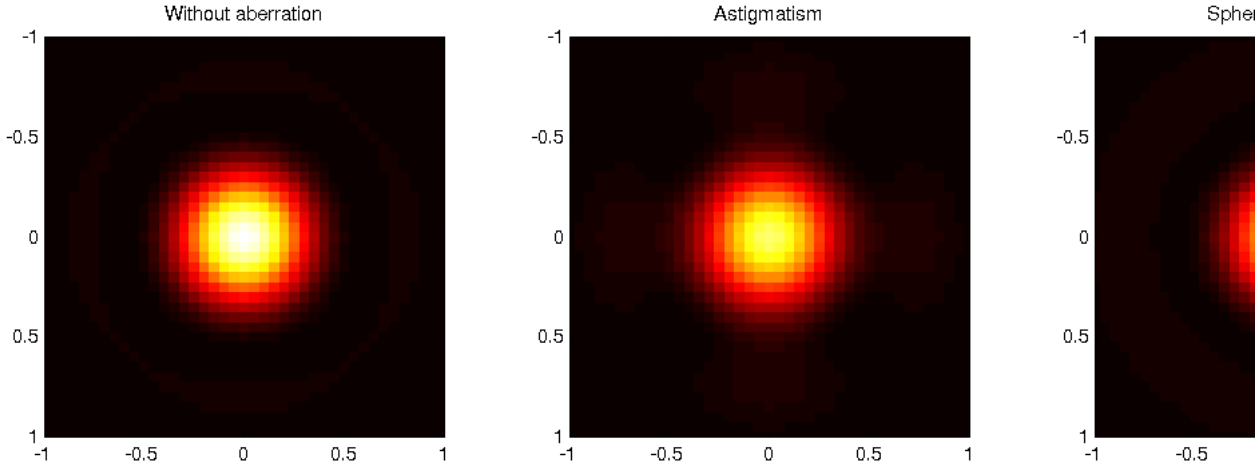
Case 3: 3D PSF with spherical aberration.

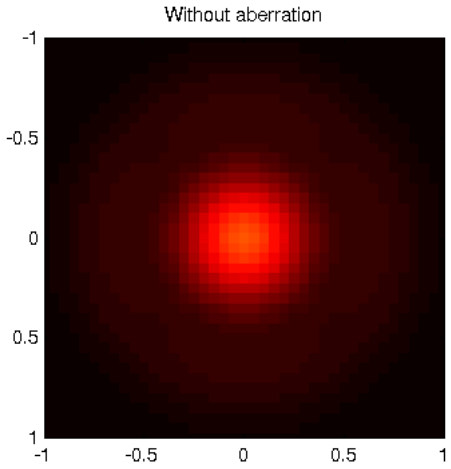
```
clear params;
params.NAo=1;
params.wavelength=1;
params.nImm=1;
params.nEmbb=1;
params.spherical=1;

spherical=microlith(v,u);

computesys(spherical,'Fluorescence',params);
computeimage(spherical,specimen,'CPU');
```

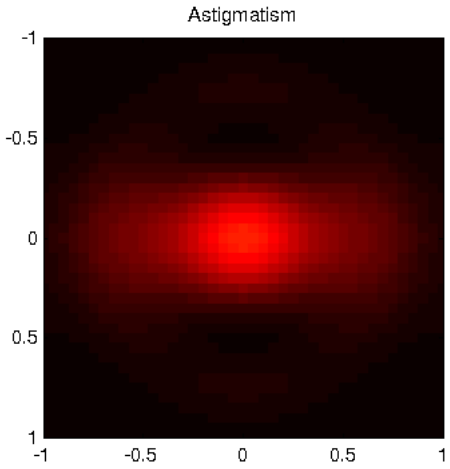
Display aberrated PSF.

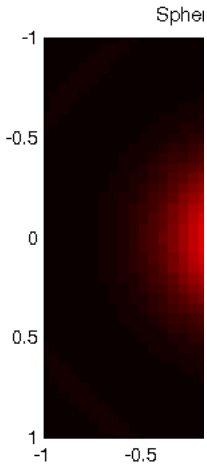
```
figure(1); set(1,'Position',[100 100 1400 400],'color','white'); colormap hot;
for idx=[10 21 30];
    clf;
    subplot(131);
    imagesc(v,v,fluor.img(:,:,idx),[0 RadioMetricFactor]); axis equal;
    title('Without aberration'); xlim([-1 1]); ylim([-1 1]);

    subplot(132);
    imagesc(v,v,astig.img(:,:,idx),[0 RadioMetricFactor]); axis equal;
    title('Astigmatism'); xlim([-1 1]); ylim([-1 1]);

    subplot(133);
    imagesc(v,v,spherical.img(:,:,idx),[0 RadioMetricFactor]); axis equal;
    title('Spherical aberration'); xlim([-1 1]); ylim([-1 1]);
    snapnow;

end
```











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