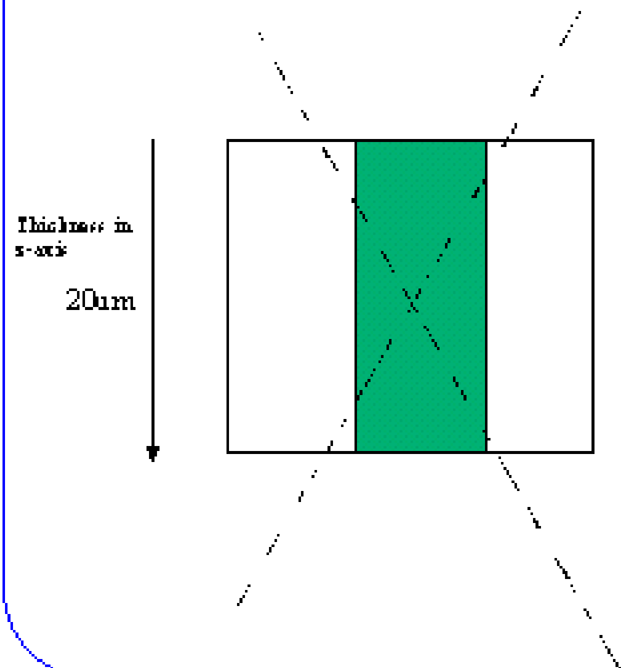
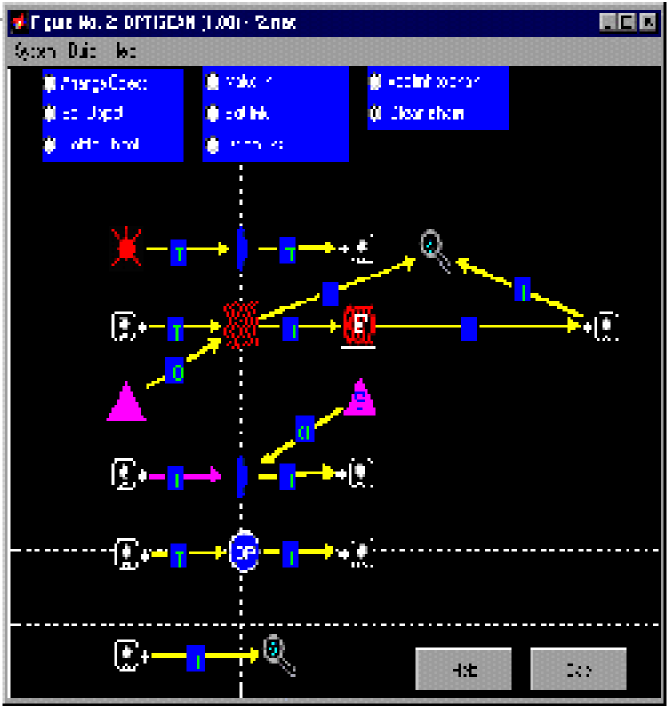
Simulation of Scanning for Incoherent Data



Project

- Illuminate fluorescent mark and pickup the incoherent data from them.
- Beam focused on the center in the z-axis
- Beam starts to propagate at the top of data.
- Data size : 3 x 3 x 20 um
- I have one data here

Scan Position of the Target



Process

3D imaging is accomplished in five steps.

Step 1(first layer): Create the illumination beam on the first layer.

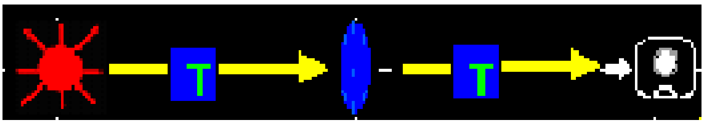
Step 2(second layer): Interact the illumination beam with the data layers with the FLUORESCENT OBJECT.

Step 3(third layer): Image the fluorescence from each layer with the pickup lens.

Step 4(fourth layer): Build the aggregate detector field on one image plane.

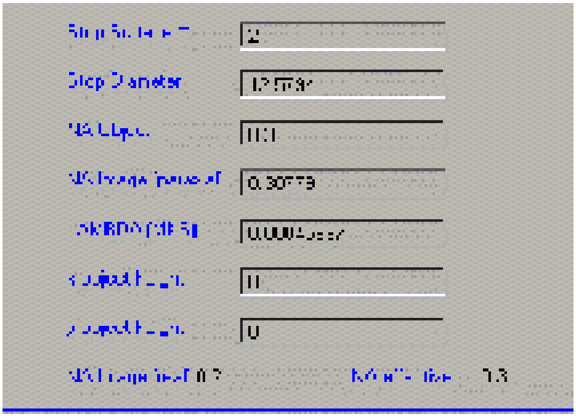
Step 5(fifth layer): View the result.

Part I-1 : Source and Lens



In the example, a laser source is used to focus into the material on the center of the data layers, which is 10um from the top of 1st layer.

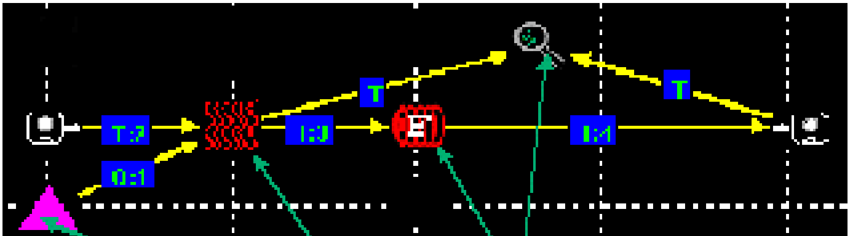
Part I-2: Lens



In the lens : change to wavelength if it is inside the material. For example,

Beam is inside the material (index of refraction = 1.5) and the wavelength of beam in the air is 0.65 um. Then make the lens wavelength -> 0.650um/1.5 =0.456um

Part II-1 :Interact the illumination beam with the data layers with the FLUORESCENT OBJECT



Here the file from Part I is used to illuminate each data plane. The wavelength of the source is set to the wavelength in the material.

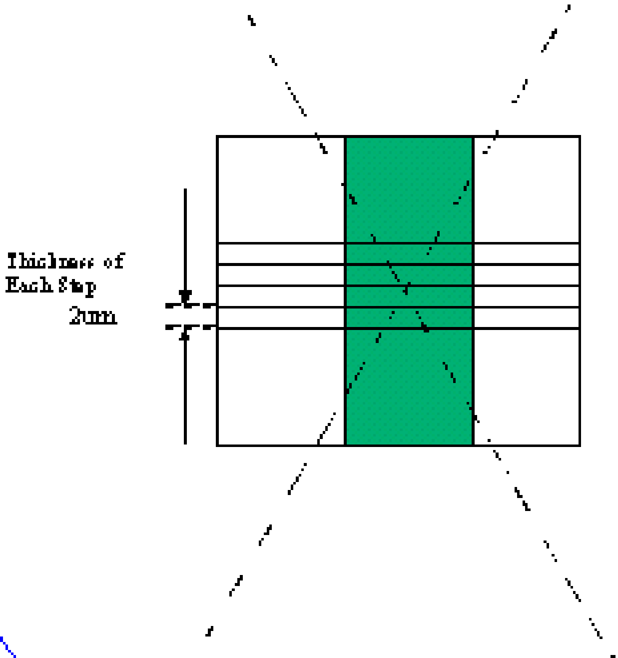
Make the step size and thickness in the del object 2um. Which means beam propagate each 2um steps in the media.

Any value is ok for the ztotal and step in the pro object. Del object take over the propagate step and thickness.

As the illumination field propagates through the data layers, it diffracts.

The fields after the pro object can be viewed easily. After the FLUORESCENT OBJECT, it takes some time to build up the fields for the look object.

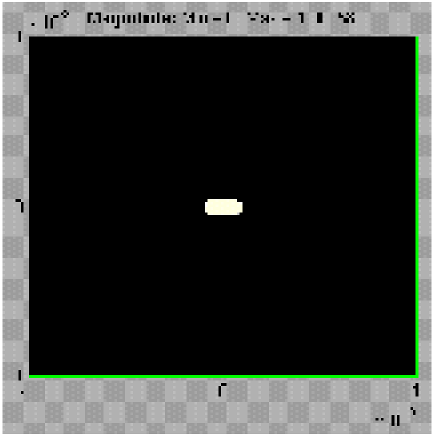
Part II-1 : Interact the illumination beam with the data layers with the FLUORESCENT OBJECT



- Depth of focus (DOF)
  : lambda/ $(n\,NA^2)$
  Step size in del object is calculated based on DOF.
  for example,
  If the data has size 20um thickness in z-axis, NA = 0.5, lambda = 0.685um, n = 1.5. Then DOF = 1.82um.

  So I choose step size 2um.
  Then I need to calculate 10 planes due to 20um / 2um = 10planes.
  We need to 10 planes, thickness of which is 2um

Part II-1 : Interact the illumination beam with the data layers with the FLUORESCENT OBJECT



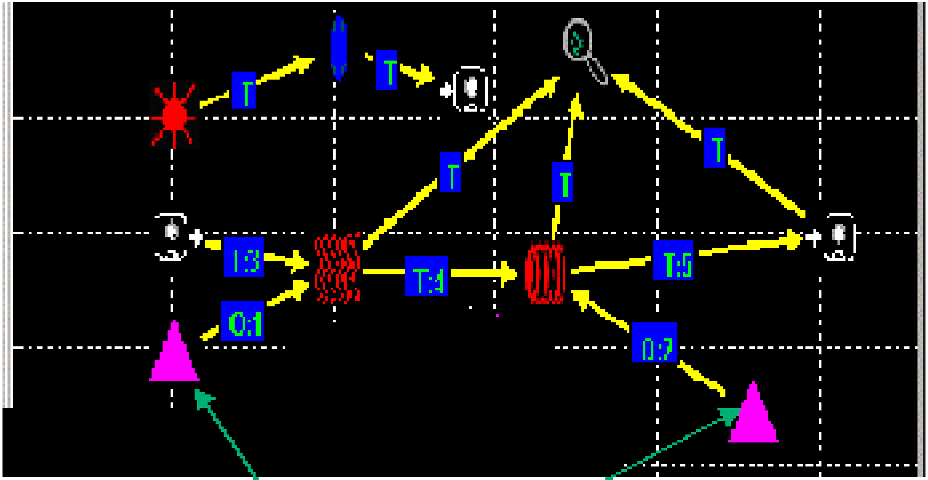
The layers are configured with the "manage layers" option in the fluorescent object.

The background is black (zero) to represent no fluorescence.

The x-y or top view of data is shown.

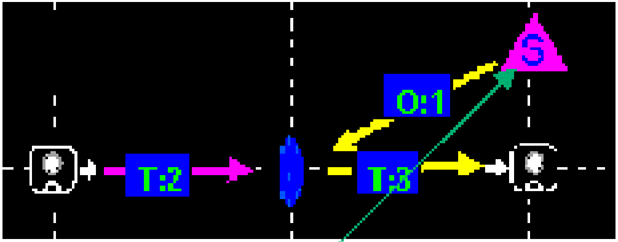
We can make any shape of data marks by making the replace option and open any bmp file that you made for mark. And you can bring it to the window that is your new mark.

Part II-2 : Scanning radially



The scanning window moves radially with the step determined by the 2nd gooey delta.
At every scanning position, get the 10 layers calculation done by the 1st gooey delta.

Part III: Image the fluorescence from each layer with the pickup lens



This is a pickup lens that reimages every electric field result including focus position and defocused positions from data layers onto the one detector plane. Also you can change the pickup lens if you like, such as different NA.

The script delta tool is used to pickup every data position including focus and defocus region.

The number of chain calculation is equal to the number of data layers.

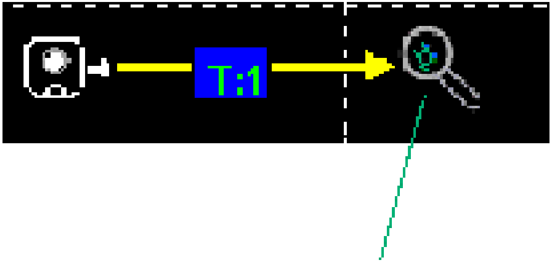
Part IV : Build the aggregate detector field

And before this process you can make all process automatically. But here you have to do by yourself for each radial position. Once you have done one radial position. Assign the filename for that calculation. And then getting result of another radial positions. And save it different name.

Example, if we have two scanning radial positions including 10 layers in the z-axial direction at each radial position, you have 20 results from part 3. 1 to 10 result is for zero center radial position. 11 to 20 result gets after 0.5µm scan radially. Then first run 1 to 10 results and save its outcome as scan_0_result. And second run 11 to 20 results and save its outcome as scan_1_result.

The OP takes the individual fields from part 3 and builds the aggregate incoherent image. The result is in units of field magnitude.

Part V : The incoherent field is reconstructed for viewing.



You can see results by LOOK object