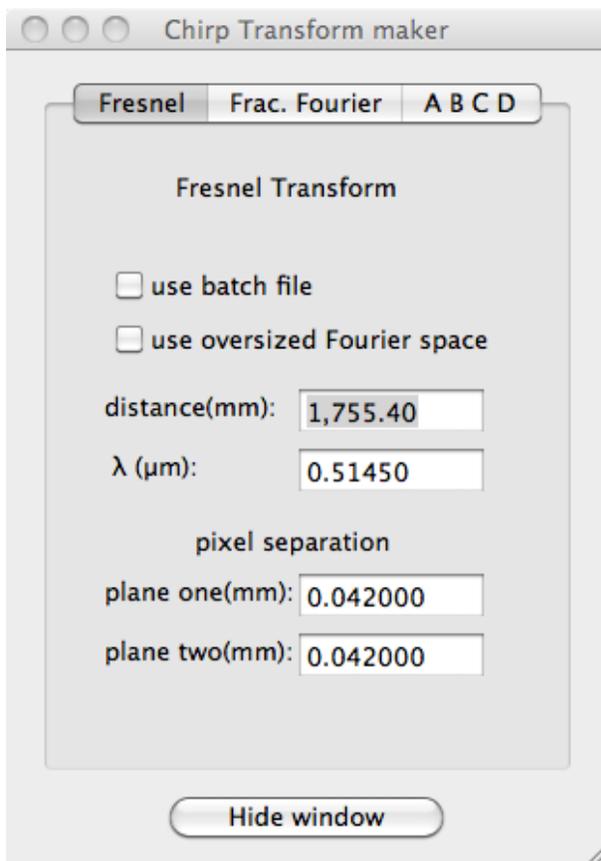


About Chirps

This icon was made to deal with the need for speed in following the evolution of a light beam. It lacks the accuracy of the “Direct Propagation” icon which permits large magnification and which includes the the effects of a finite source pixel, but it is very much faster. When used on a Macintosh computer with several cores it will really fly.

The icon has three pages. All of the pages and their associated algorithms make use of multiple FFT’s and quadratic phase functions [aka lens functions or ZPF]. The page which is open when the icon window is closed determines the operation and the algorithms to be used.

FRESNEL TRANSFORM



We think of the propagation through a distance “ d ” as represented by the ray

matrix: $\begin{pmatrix} 1 & d \\ 0 & 1 \end{pmatrix}$ this matrix represents an operation which in this instance is

represented by two algorithms, one if the pixel separations are the different and another simpler one if the same.

if “ Δ_1 ” is the pixel center to center distance in plane one. “ Δ_2 ” is the equivalent for plane two. The wave length of the light is “ λ ”. The width (and height) of the array in pixels is “ N ”. The (x,y) pixel coordinates are (n,m) . The calculation has five parts.

- 1) multiplication by a lens function.
- 2) a fast inverse Fourier transform.
- 3) another lens function.
- 4) a fast Fourier transform
- 5) a final lens function.

The lens functions have a phase defined as follows.

$$\phi_1 = \frac{\pi \Delta_1}{\lambda d} (\Delta_1 - \Delta_2) (n^2 + m^2)$$

$$\phi_3 = \frac{\pi \lambda d}{N^2 \Delta_1 \Delta_2} (n^2 + m^2)$$

$$\phi_5 = \frac{\pi \Delta_2}{\lambda d} (\Delta_2 - \Delta_1) (n^2 + m^2)$$

Steps one and five are skipped if Δ_1 equals Δ_2 . You will find that you can magnify the output if Δ_2 is smaller than Δ_1 , just as in “direct propagation”.

Clicking the “**use oversized Fourier space**”

box, doubles the size of N in these equations. The size of the array between each of these steps is the original size. The purpose of this is to reduce the effects of circular