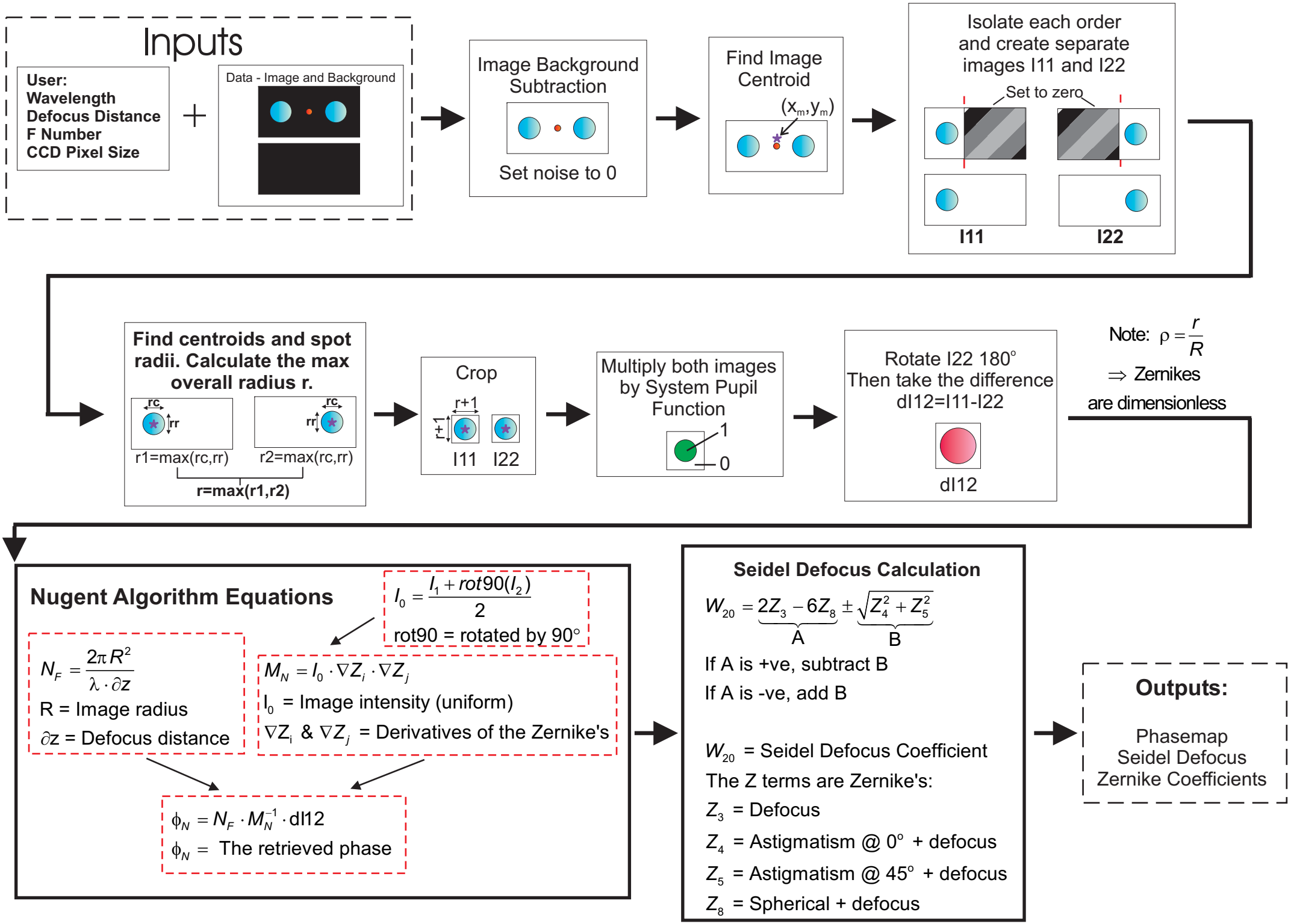
Inputs
User:
Wavelength
Defocus Distance
F Number
CCD Pixel Size
Data - Image and Background
Image Background Subtraction
Set noise to 0
Find Image Centroid
(x_m,y_m)
Isolate each order and create separate images I11 and I22
Set to zero
I11
I22
Find centroids and spot radii. Calculate the max overall radius r.
rc
rr
r1=max(rc,rr)
r2=max(rc,rr)
r=max(r1,r2)
Crop
r+1
I11
I22
Multiply both images by System Pupil Function
1
0
Rotate I22 180°
Then take the difference
dI12=I11-I22
dI12
Note: $\rho = \frac{r}{R}$
⇒ Zernikes are dimensionless
Nugent Algorithm Equations
$I_0 = \frac{I_1 + rot90(I_2)}{2}$
rot90 = rotated by 90°
$N_F = \frac{2\pi R^2}{\lambda \cdot \partial z}$
R = Image radius
∂z = Defocus distance
$M_N = I_0 \cdot \nabla Z_i \cdot \nabla Z_j$
I_0 = Image intensity (uniform)
∇Z_i & ∇Z_j = Derivatives of the Zernike's
$\phi_N = N_F \cdot M_N^{-1} \cdot dI12$
ϕ_N = The retrieved phase
Seidel Defocus Calculation
$W_{20} = \underbrace{2Z_3 - 6Z_8}_{A} \pm \underbrace{\sqrt{Z_4^2 + Z_5^2}}_{B}$
If A is +ve, subtract B
If A is -ve, add B
W_{20} = Seidel Defocus Coefficient
The Z terms are Zernike's:
Z_3 = Defocus
Z_4 = Astigmatism @ 0° + defocus
Z_5 = Astigmatism @ 45° + defocus
Z_8 = Spherical + defocus
Outputs:
Phasemap
Seidel Defocus
Zernike Coefficients