Angular Spectrum Method

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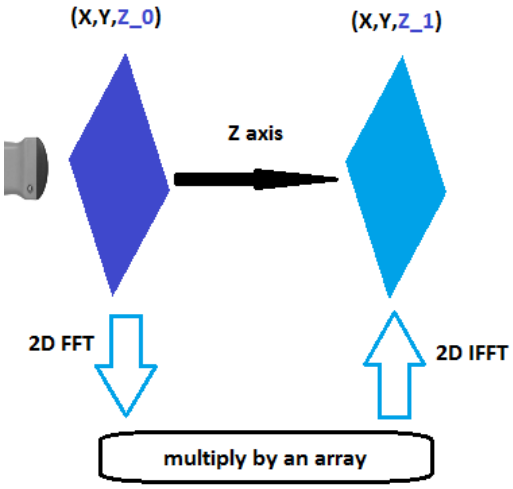
ASM
Powerful technique for modeling the propagation of acoustic fields



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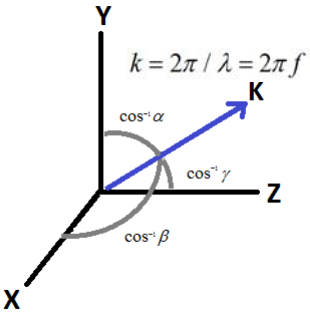
The Maths behind:



$$A.S(\frac{\alpha}{\lambda},\frac{\beta}{\lambda},0)=\iint \phi(x,y,0)e^{-i2\pi\left(\frac{\alpha}{\lambda}x+\frac{\beta}{\lambda}y\right)}dxdy$$

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$$A.S(kx,ky,z_0)=A.S(kx,ky,z1)e^{-i|kz|(Z1-Z0)} \quad \text{for } kz^2>0$$

$$A.S(kx,ky,z_0)=A.S(kx,ky,z1)e^{-|kz|(Z1-Z0)} \quad \text{for } kz^2<0$$

$$H(kx,ky,z_{1\,/\,}z_0)=\begin{cases} e^{-i(Z1-Z0)\sqrt{k^2-(kx^2+ky^2)}} & \text{for } kz^2 \neq 0 \\ 1 & \text{for } Z_1\text{-}Z_0=0 \end{cases}$$

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Summary:

1) Makes 2D-FT of any field distribution in Zo:

$$A.S(kx,ky,z_0)=\iint \phi(x,y,z_0)e^{-i(kx\bullet x+ky\bullet y)}dxdy$$

2) Multiply the result by H(array):

$$H(kx,ky,z_1/z_0)=e^{-i(Z1-Z0)\sqrt{k^2-(kx^2+ky^2)}}$$

3) Make the 2D-IFT to get the propagated field:

$$\phi(x,y,z_1)=\iint A.S(x,y,z_1)e^{i(kx\bullet x+ky\bullet y)}dkx\cdot dky$$

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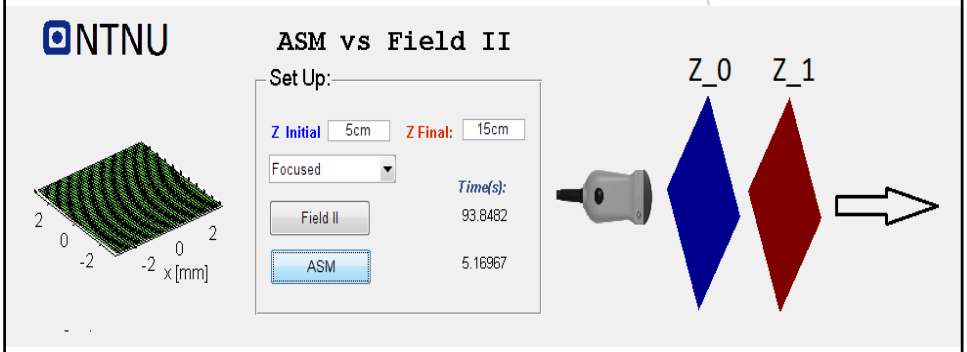
Experiment:



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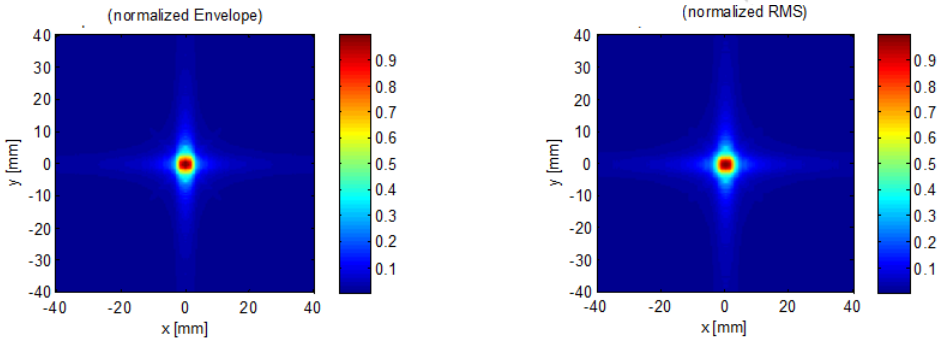
source plane in Field II



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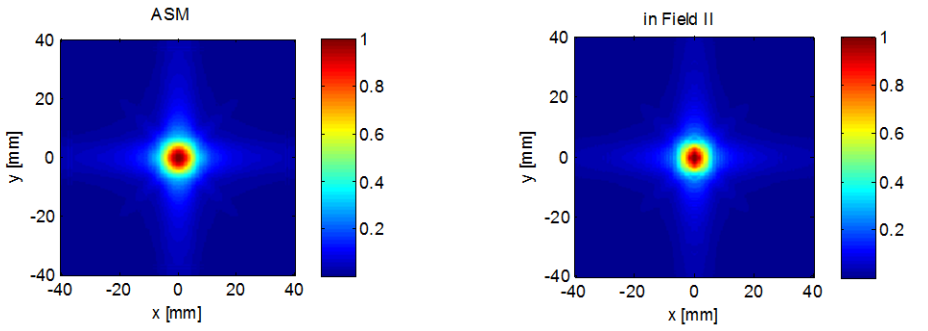
propagated plane (normalized envelope)



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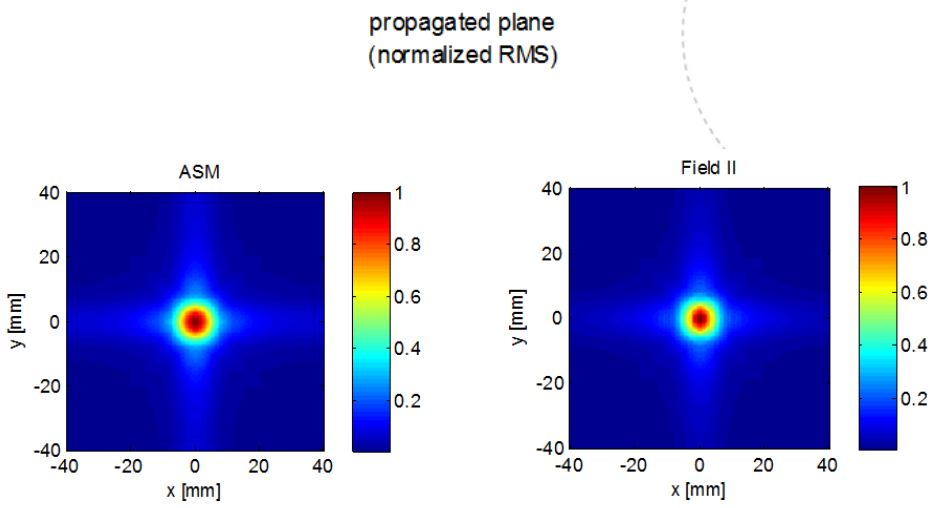

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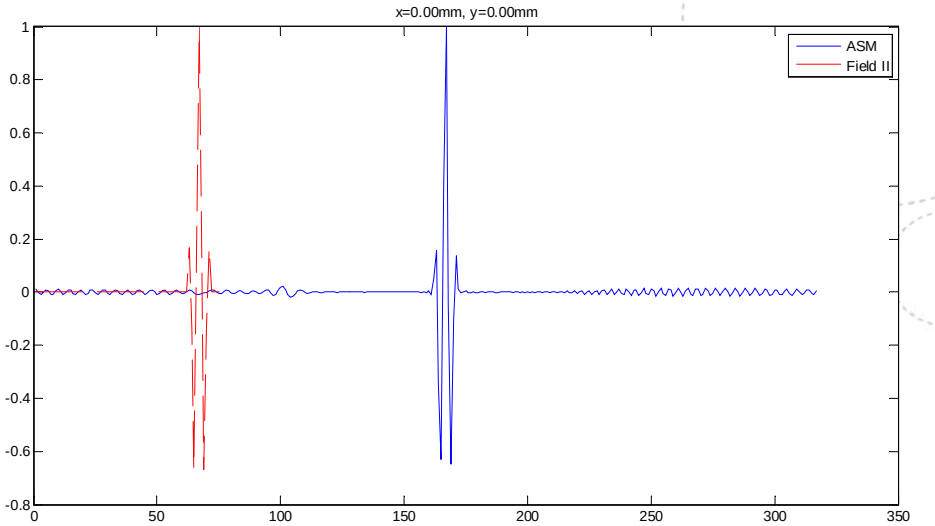

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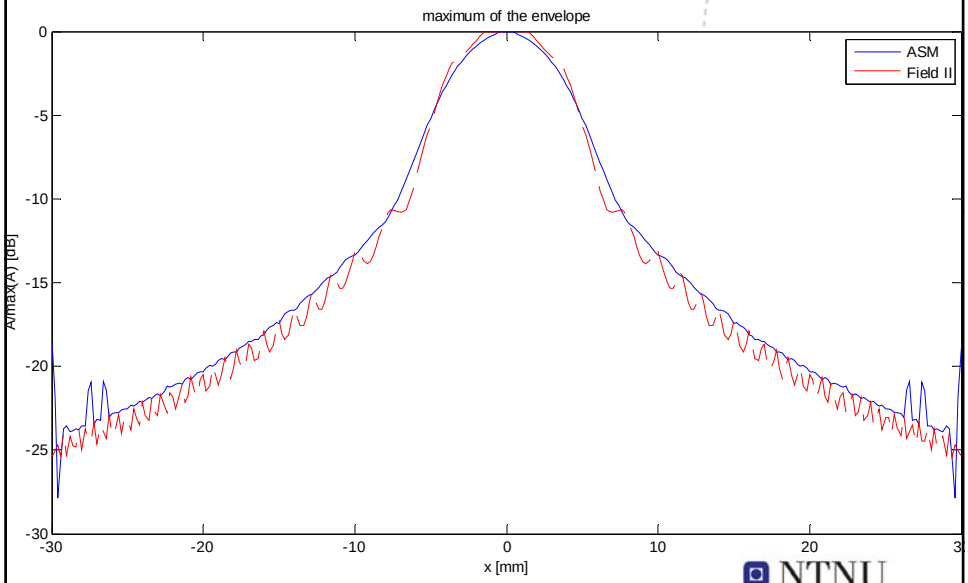

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