

On the Connections between Radiation Synthesis and Sound Field Synthesis using Linear Arrays

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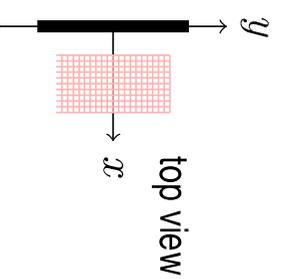
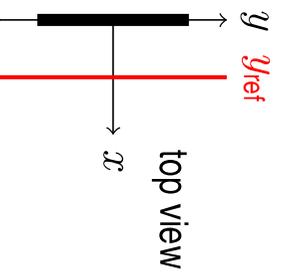
Research Group Signal Processing and Virtual Acoustics

41. DAGA, Nürnberg

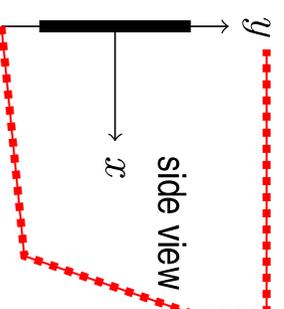
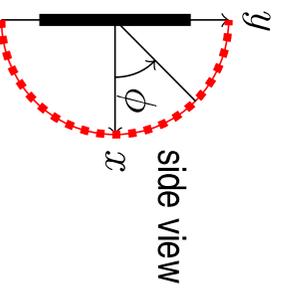
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Applications for Sound Field and Radiation Synthesis

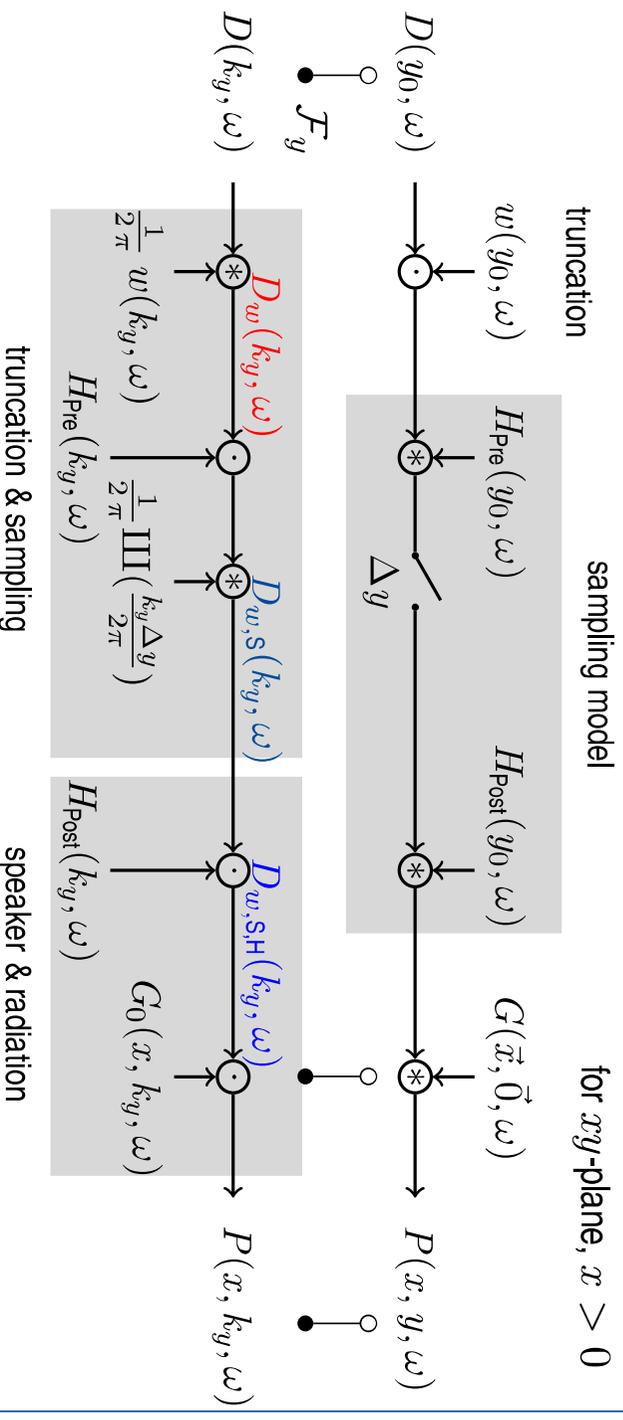
Sound Field Synthesis (SFS)



Radiation Synthesis (RS)



Signal Processing Model for Sound Field Synthesis



farfield radiation pattern in **visible** region $|k_y| \leq |\frac{\omega}{c}|$, $-90^\circ \leq \phi \leq +90^\circ$

$D_w(k_y, \omega)$...continuous, finite length LA

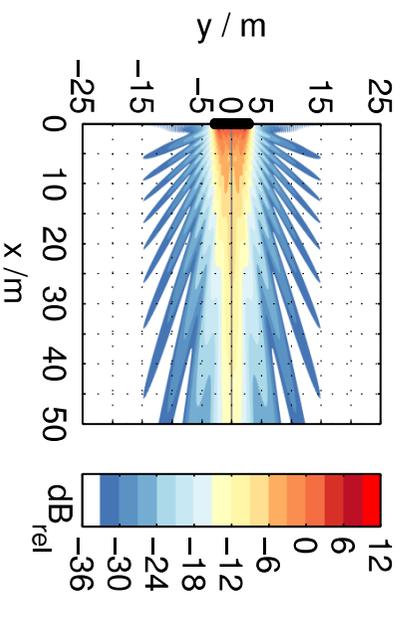
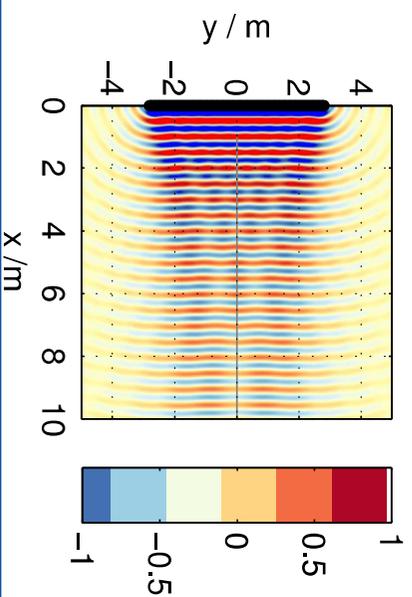
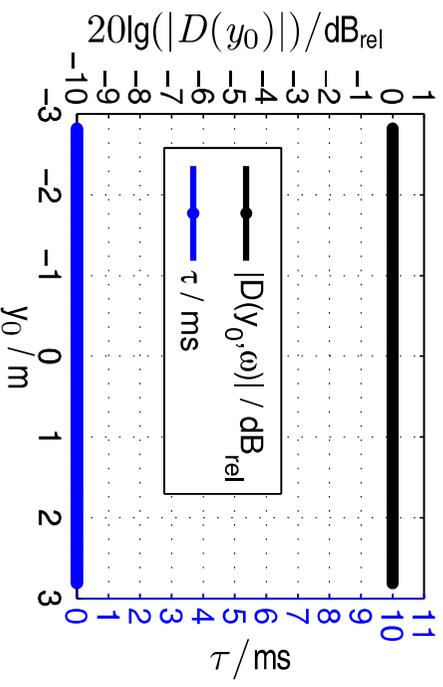
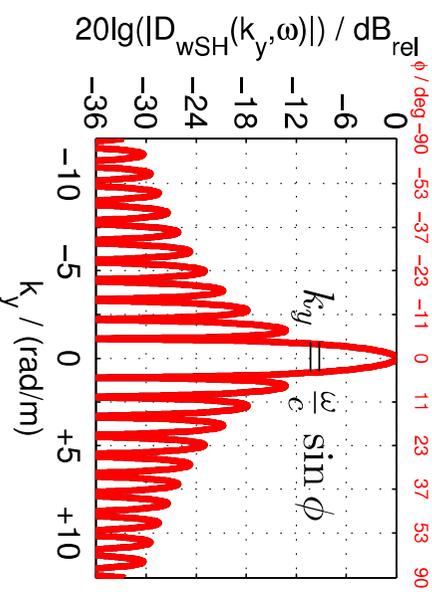
$D_{w,s}(k_y, \omega)$...discretized, finite length, point source LA (array factor)

$D_{w,s,H}(k_y, \omega)$...discretized, finite length, loudspeaker LA (1st product theorem, final array factor)

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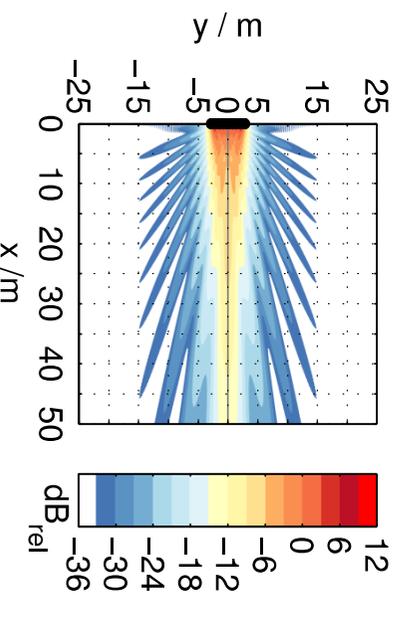
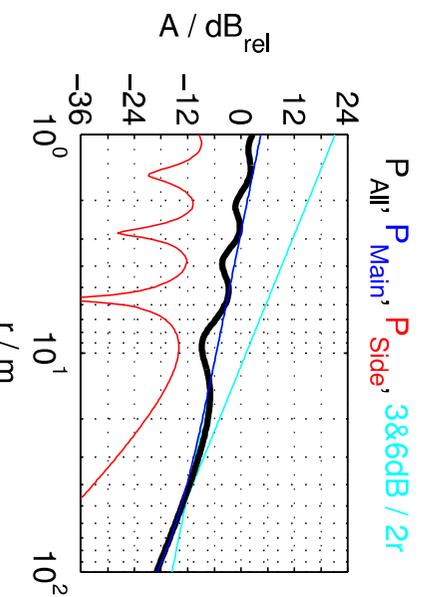
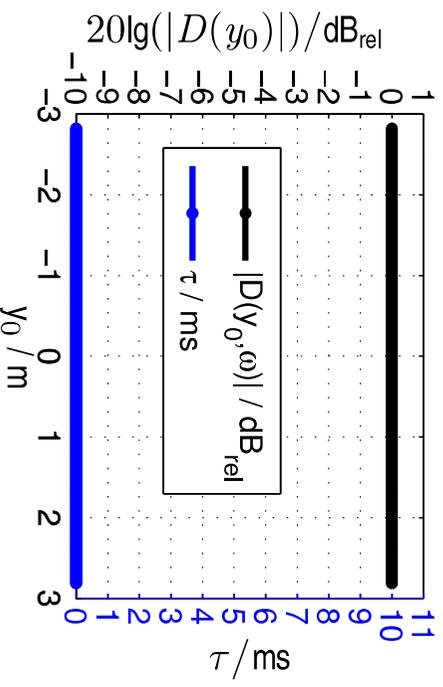
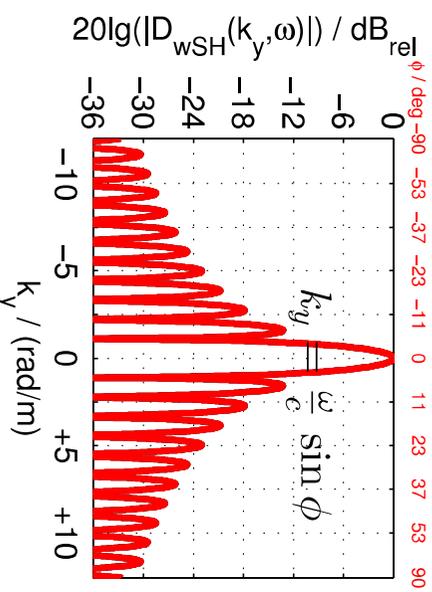
Plane Wave

$L \approx 5.66 \text{ m}$, $\lambda = 0.5 \text{ m} \rightarrow f = 686 \text{ Hz}$, rectangular window



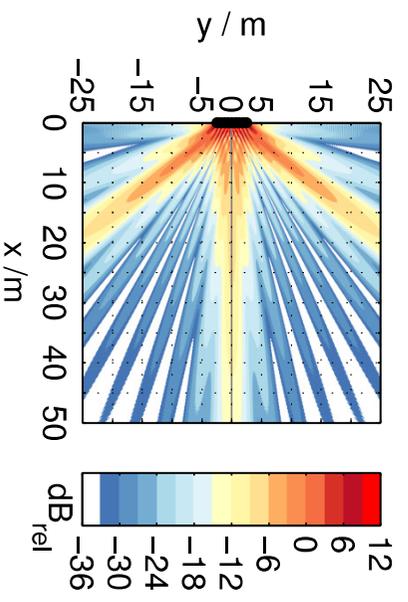
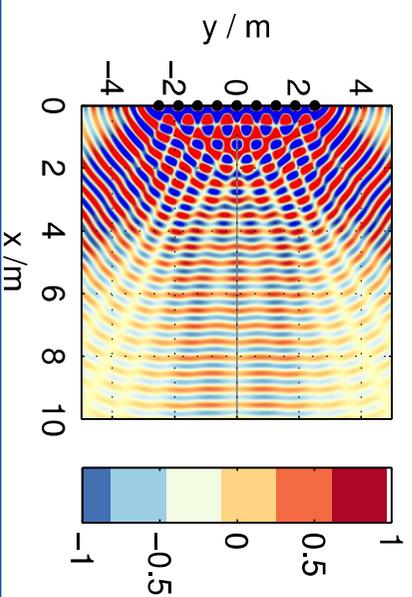
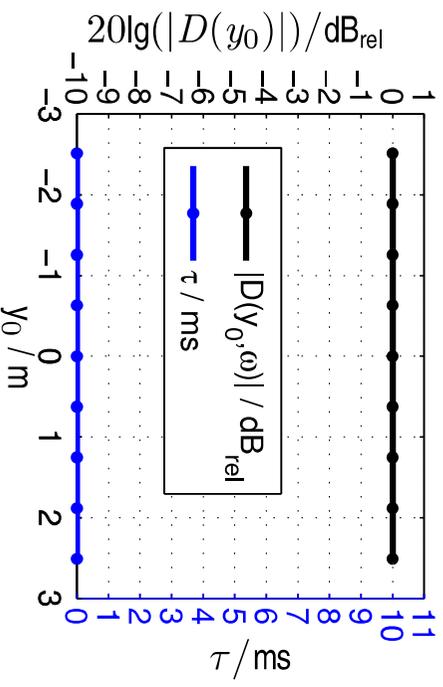
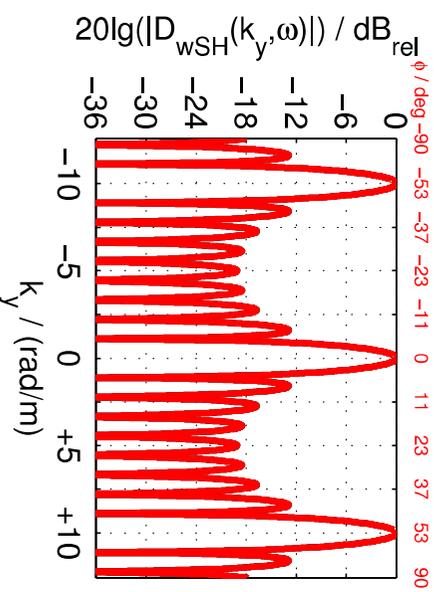
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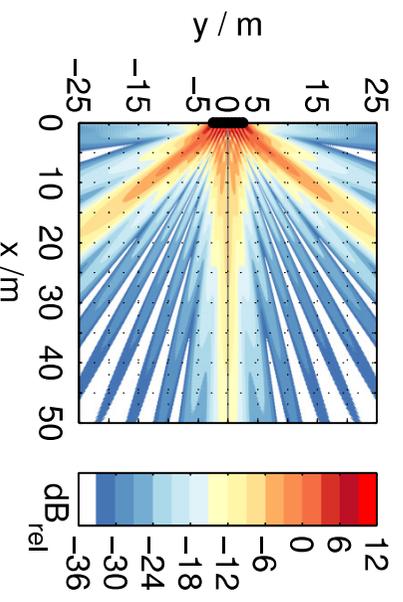
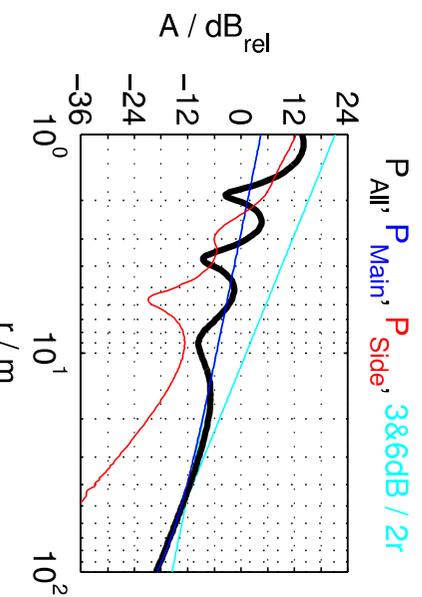
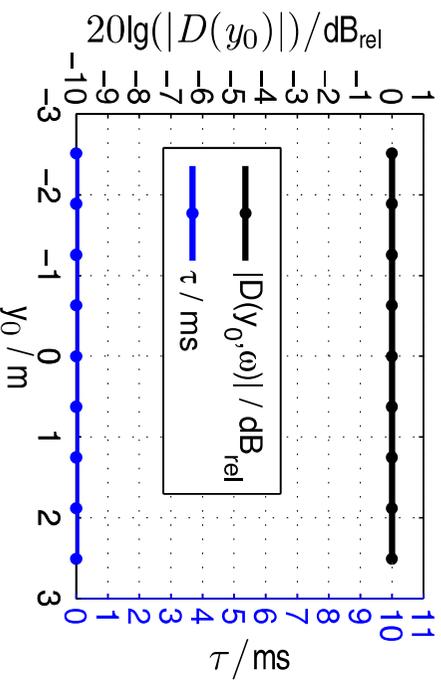
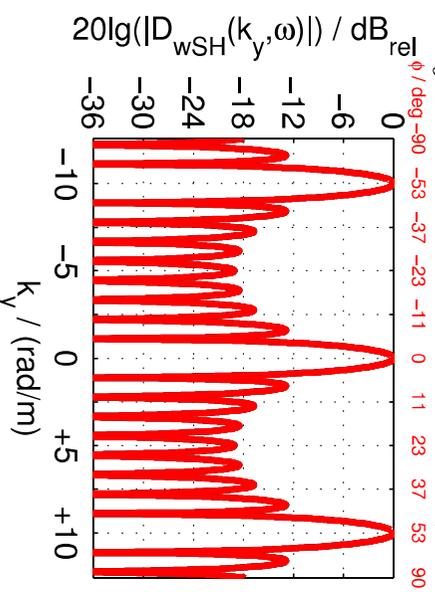
Plane Wave with Spatial Aliasing

$$\Delta k_y = 10 \text{ rad/m} \rightarrow \Delta y = 2\pi / \Delta k_y \approx 0.63 \text{ m}$$



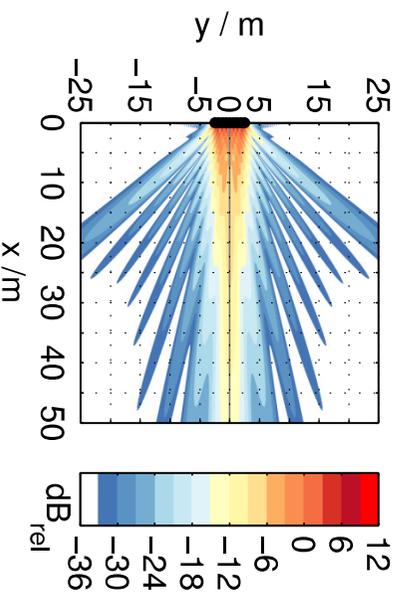
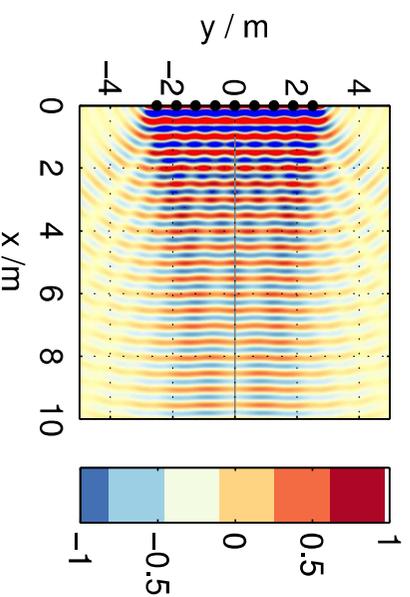
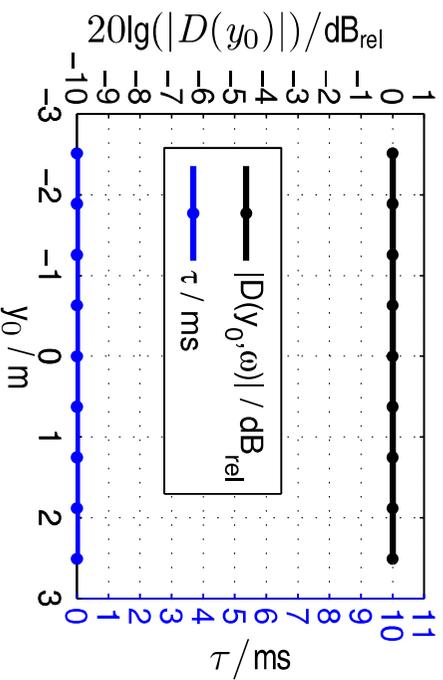
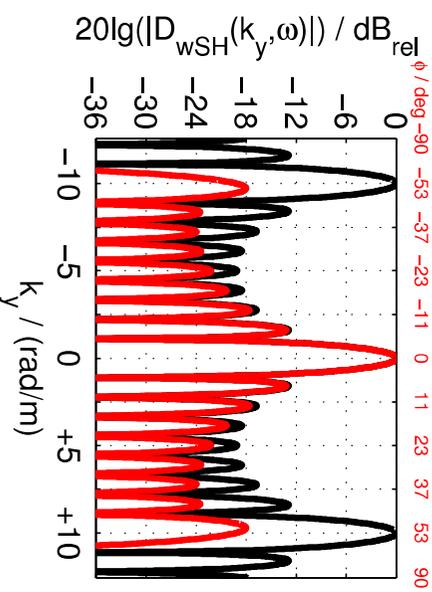
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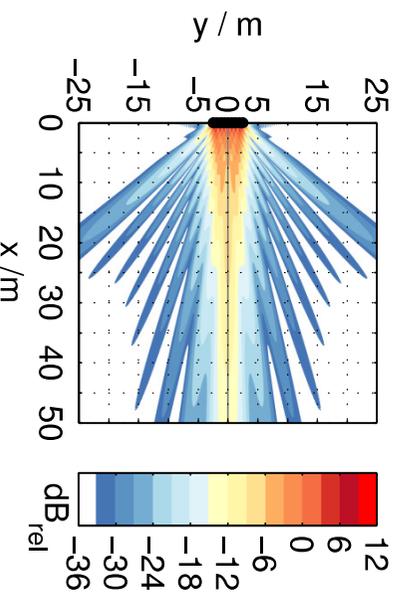
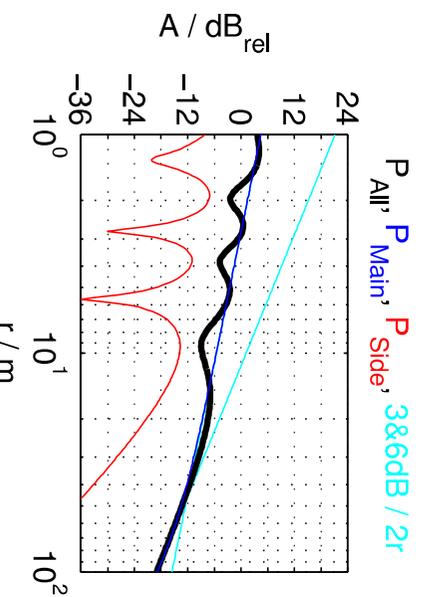
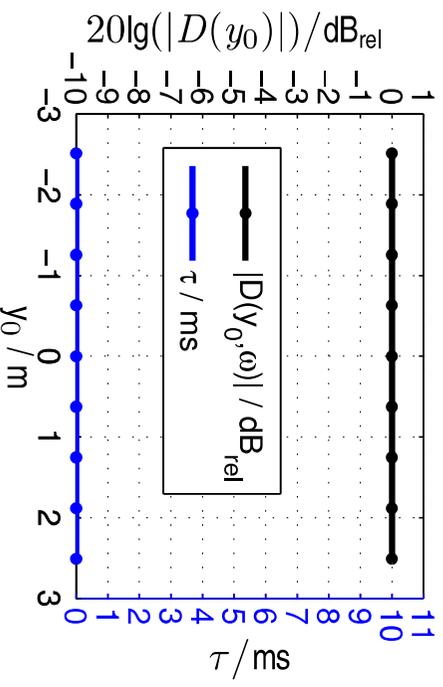
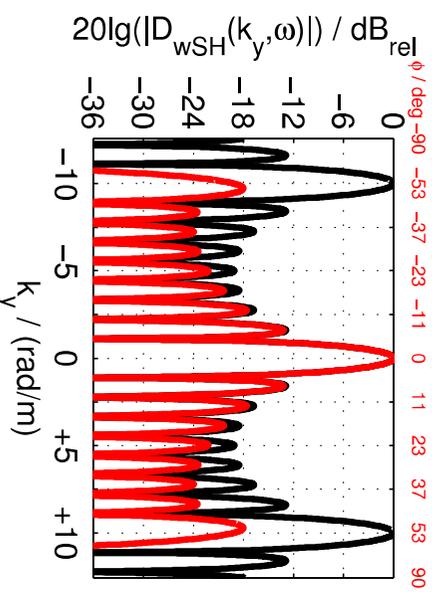
Plane Wave with Spatial Aliasing & Postfilter

$\Delta y \approx 0.63$ m, line piston with length $l \approx 0.57$ m, $l/\Delta y = 0.9$



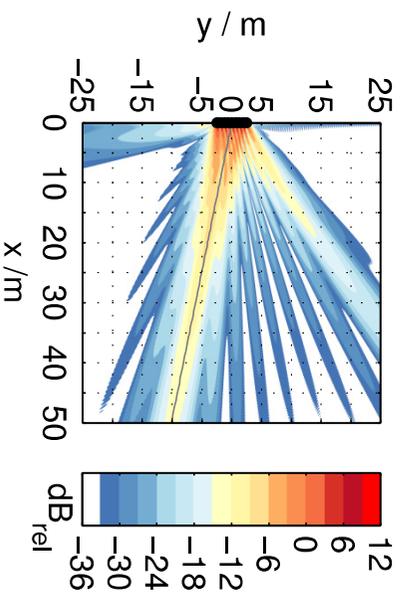
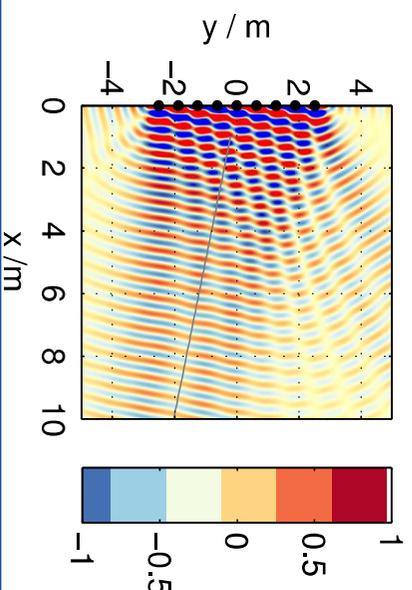
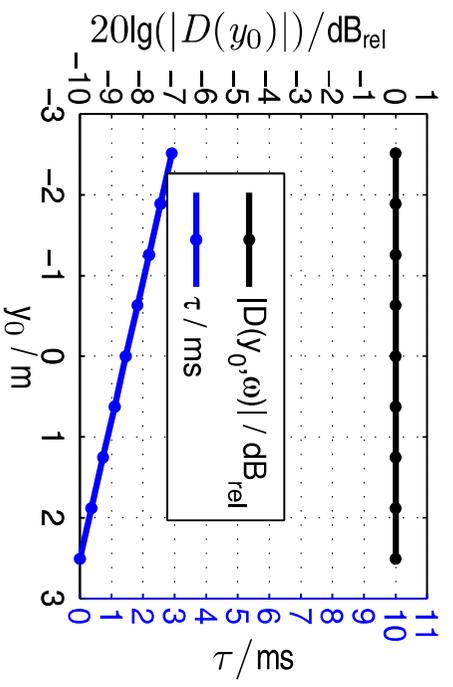
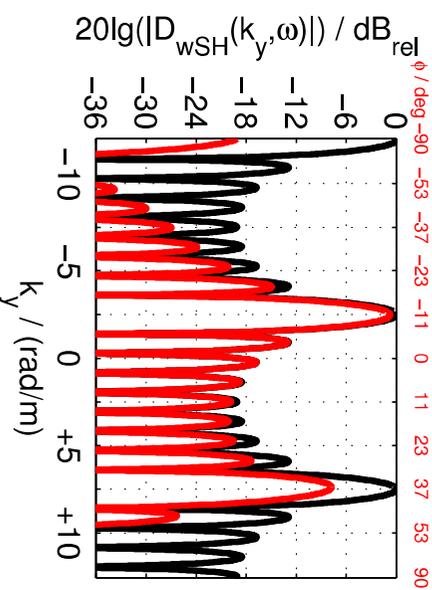
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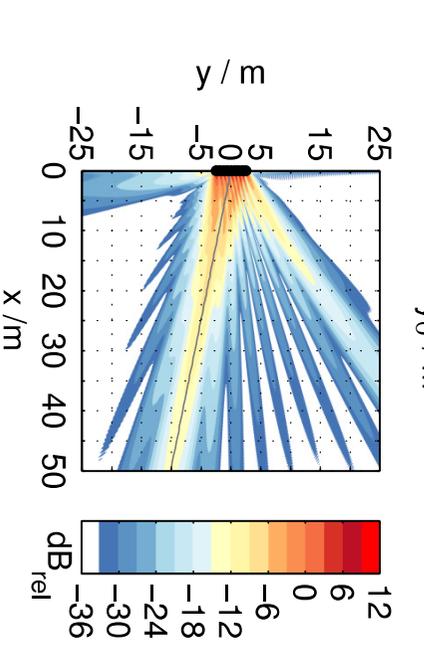
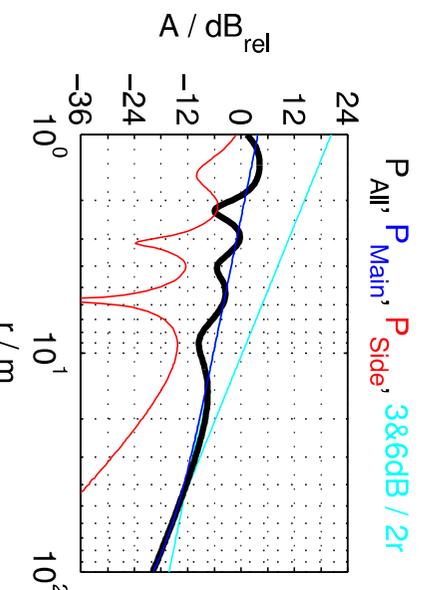
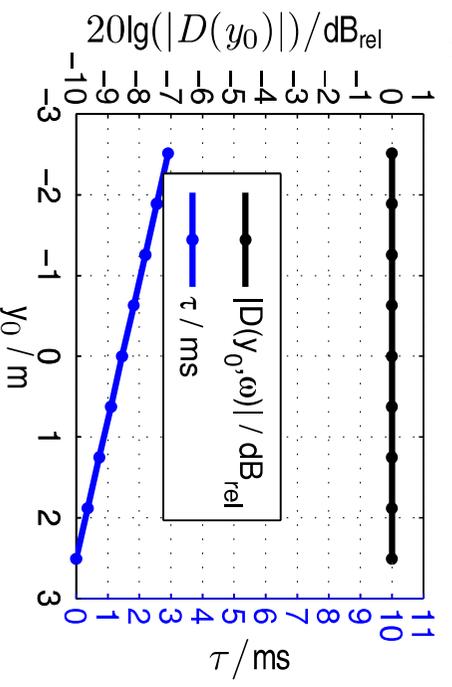
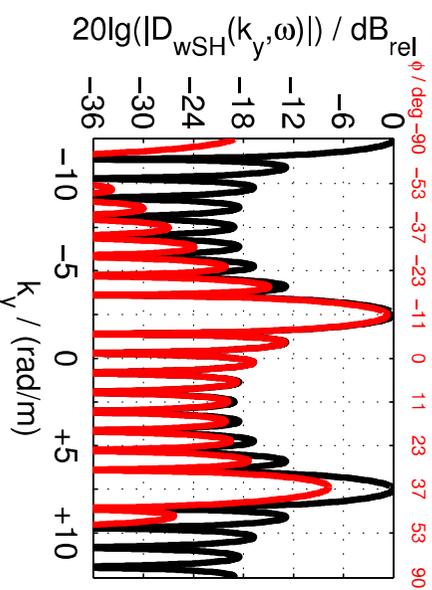
Steered Plane Wave with Spatial Aliasing & Postfilter

$$k_{y, \text{steer}} = -2.5 \text{ rad/m} \rightarrow \phi_{\text{steer}} = \text{asin}(k_{y, \text{steer}} / (\omega / c)) \approx -11.5^\circ$$



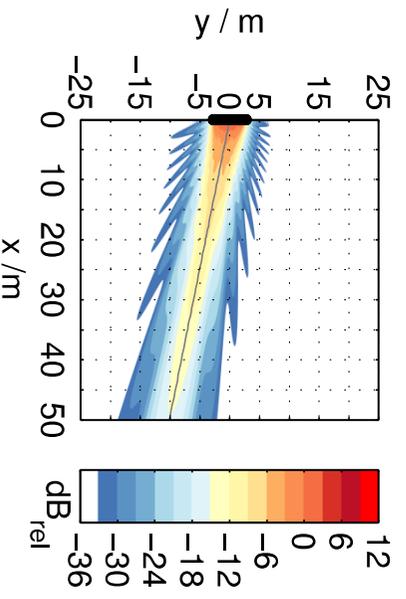
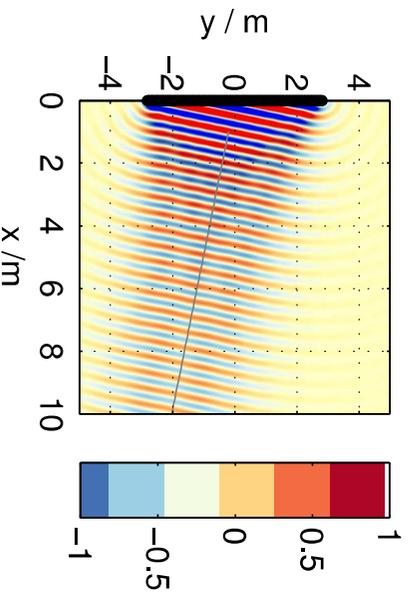
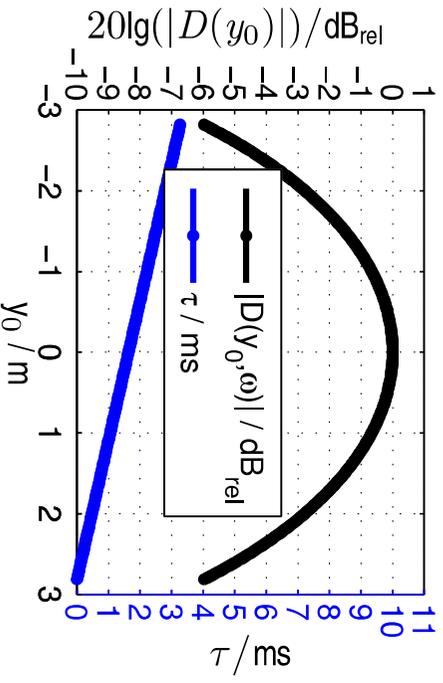
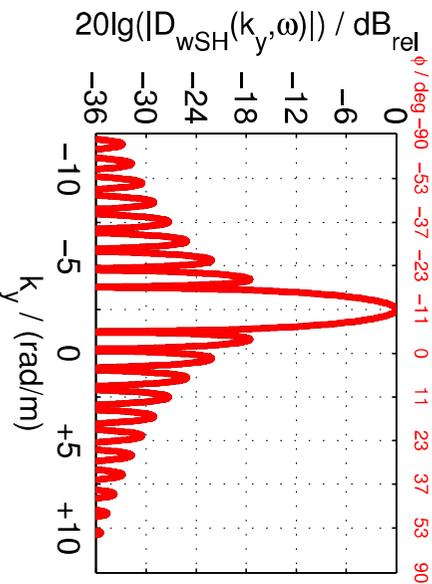
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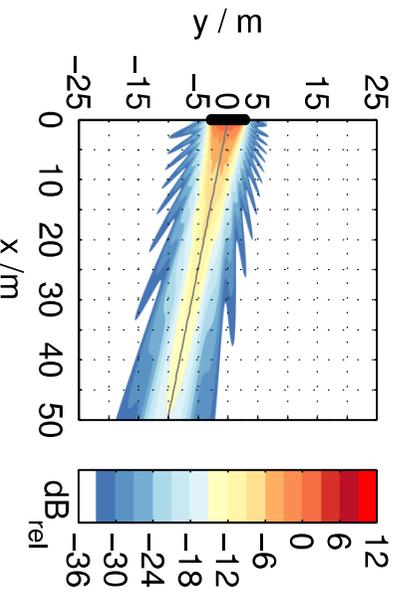
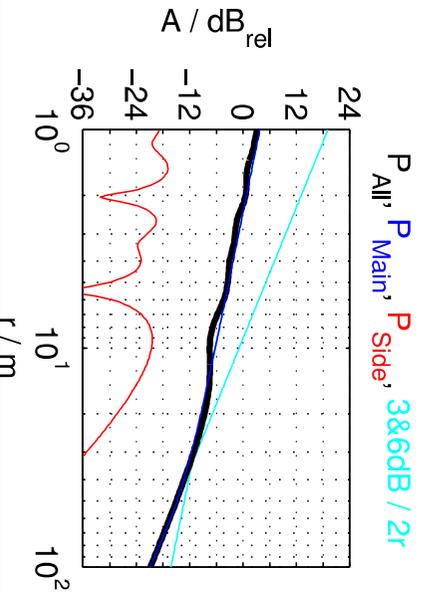
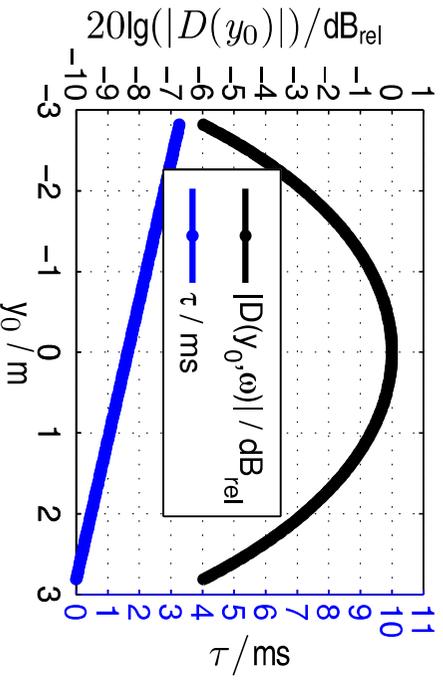
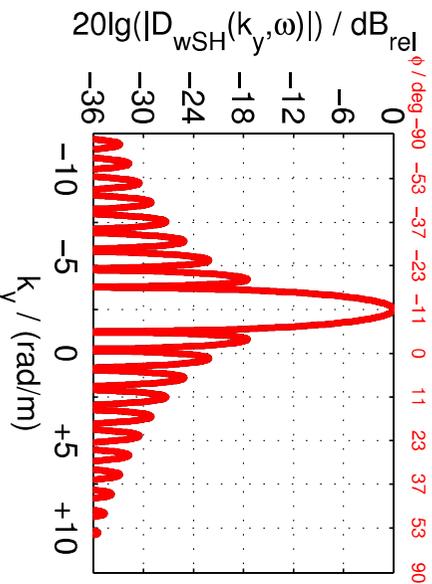
Steered Plane Wave, Window

$\phi_{\text{steer}} \approx -11.5^\circ$, Kaiser-Bessel window $\beta = 1.8$



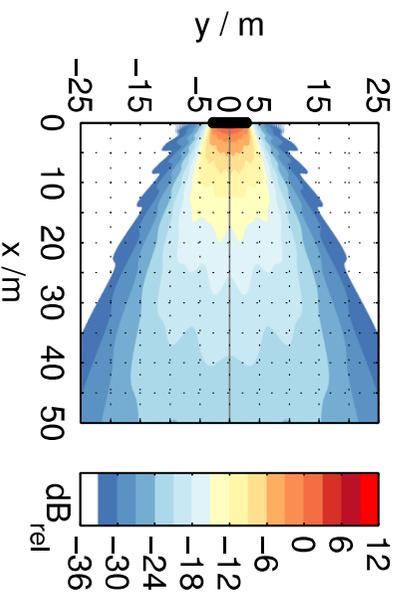
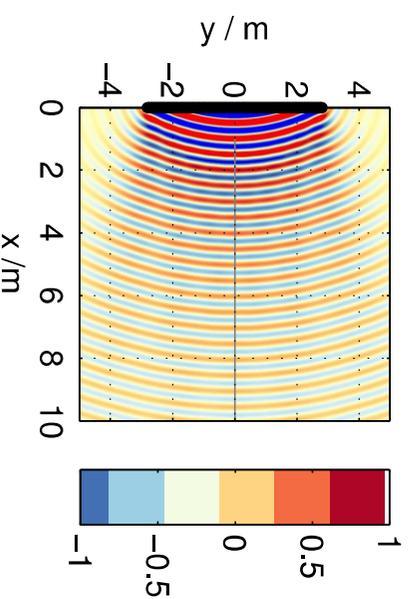
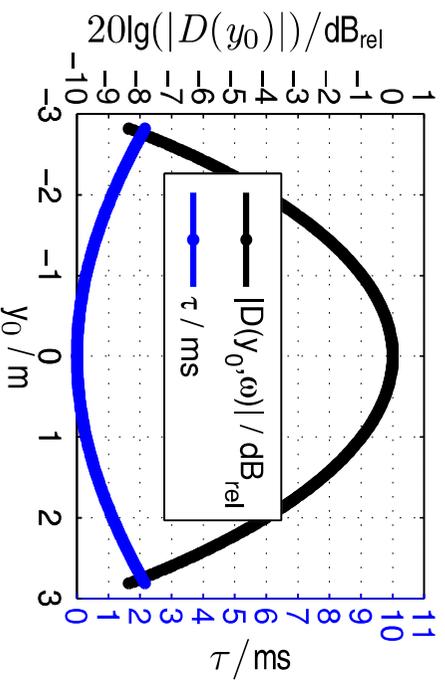
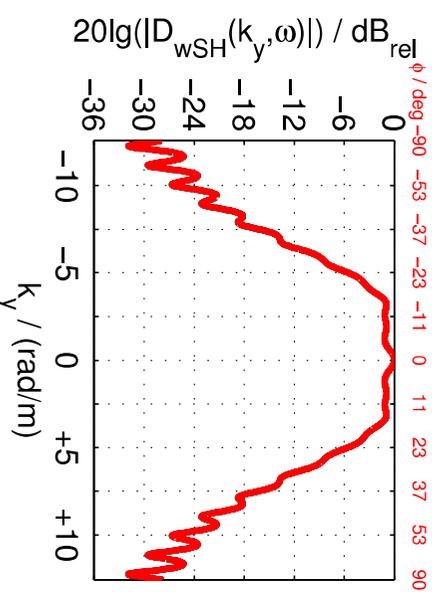
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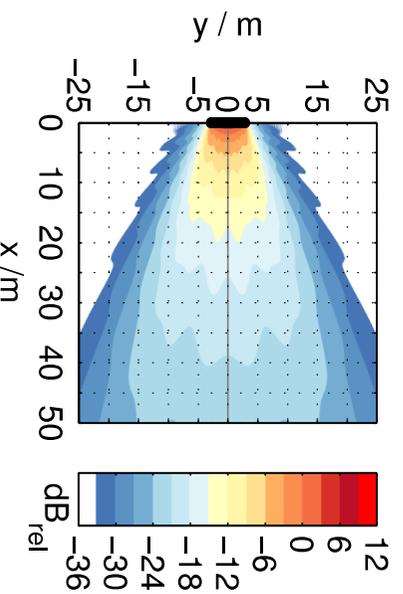
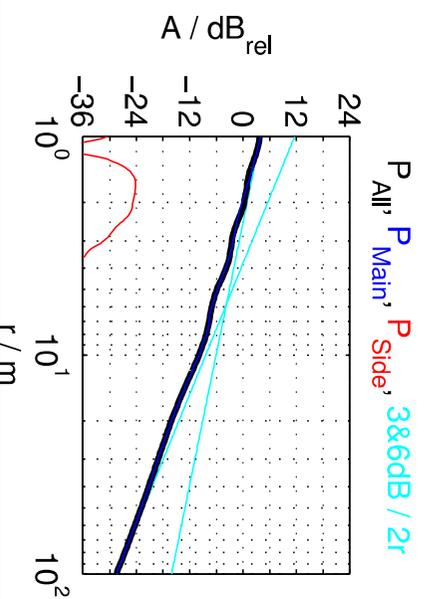
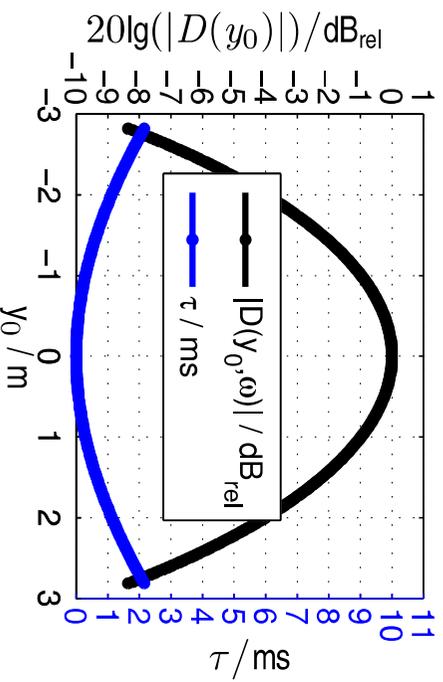
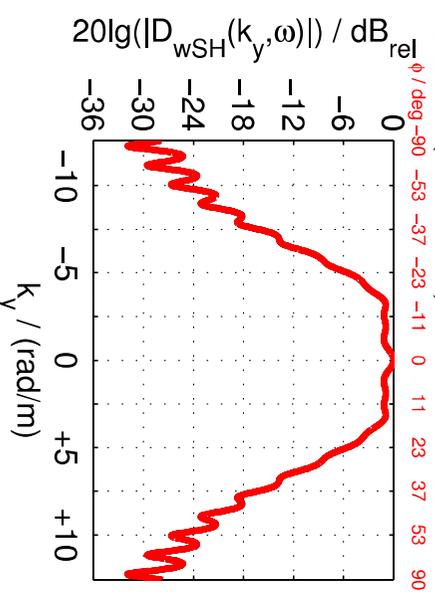
Spherical Wave, Window

$x_{PS} = (-5, 0, 0)^T$, Kaiser-Bessel window $\beta = 1.9$



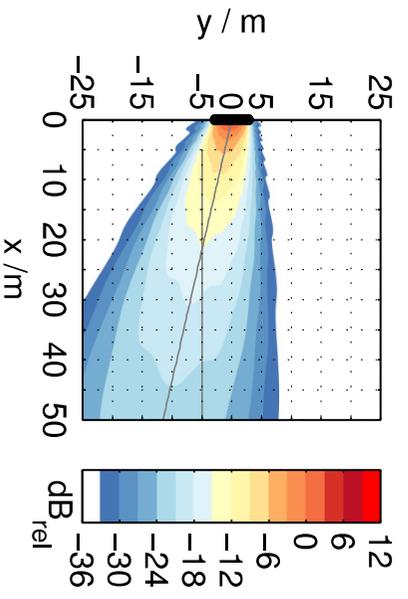
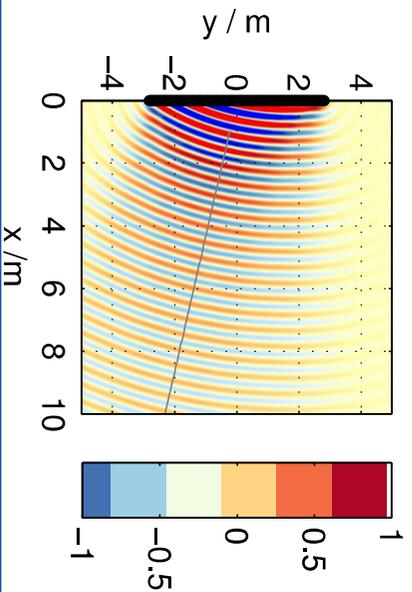
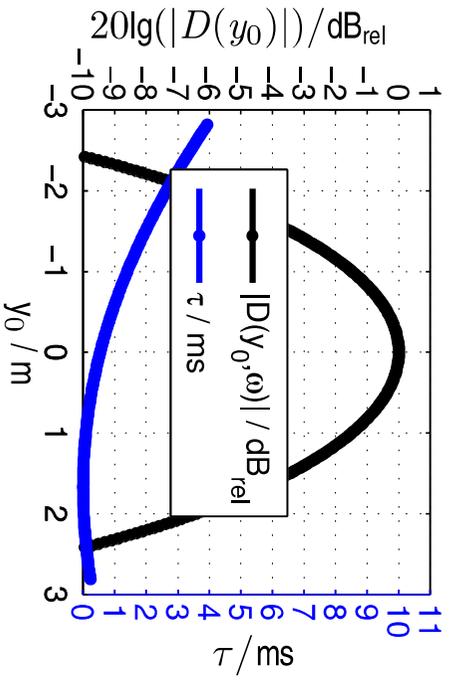
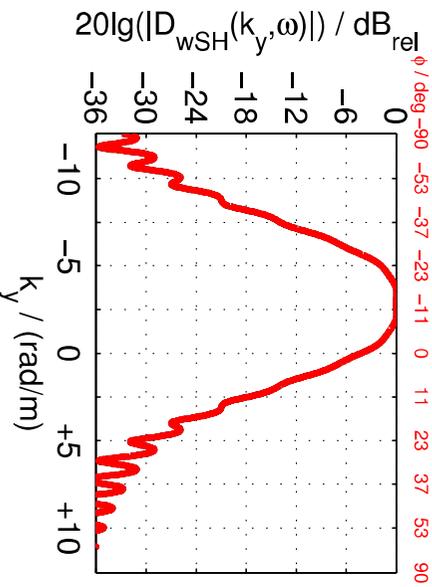
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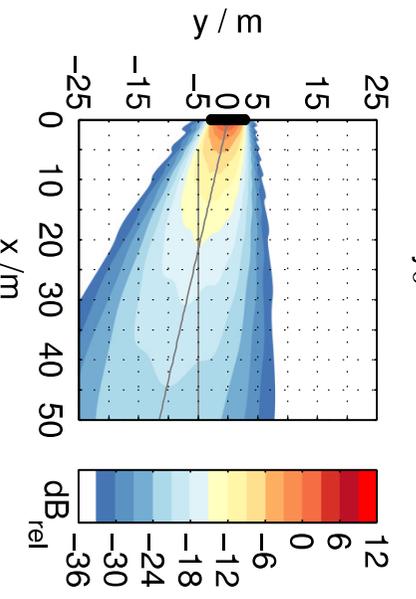
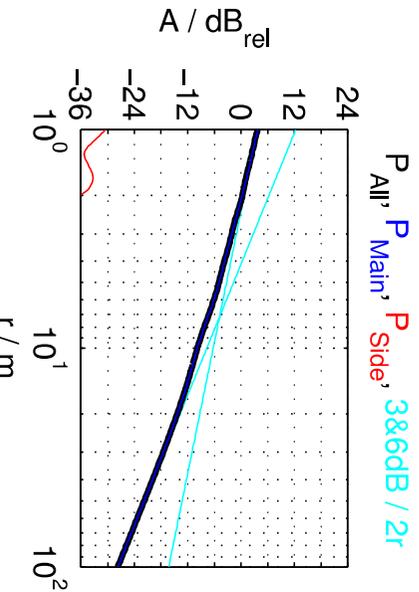
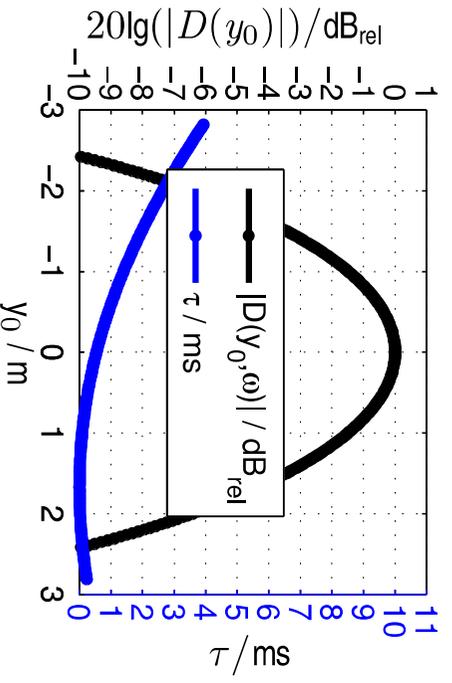
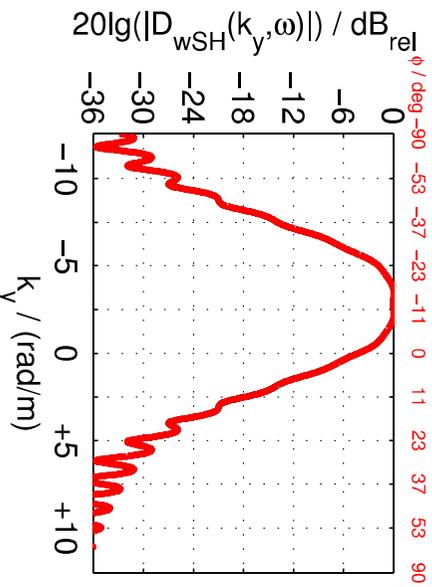
Steered Spherical Wave, Window

$x_{PS} = (-7.25, 0, 0)^T$, Kaiser-Bessel window $\beta = 3, \phi_{steer} = -13^\circ$



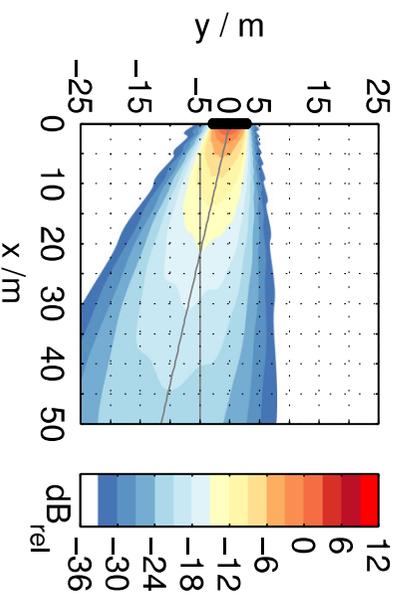
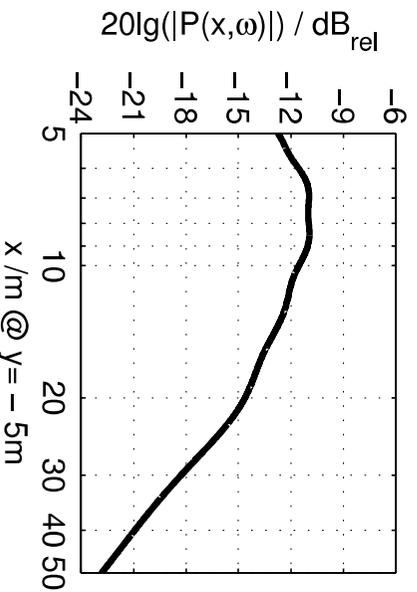
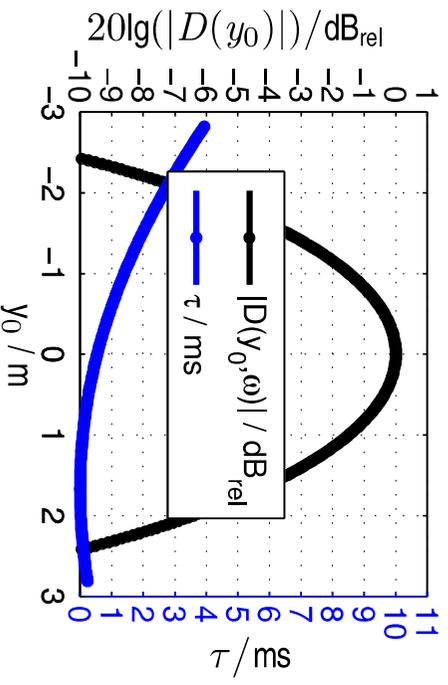
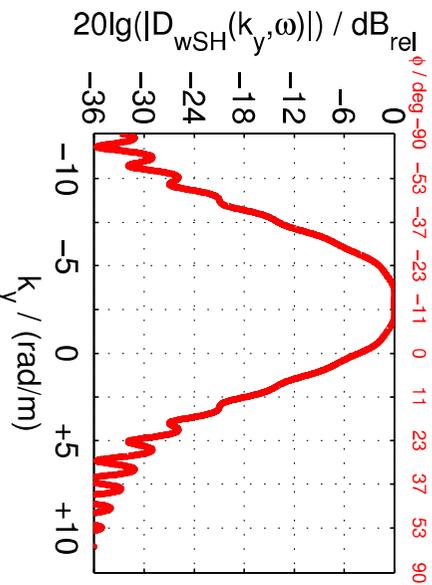
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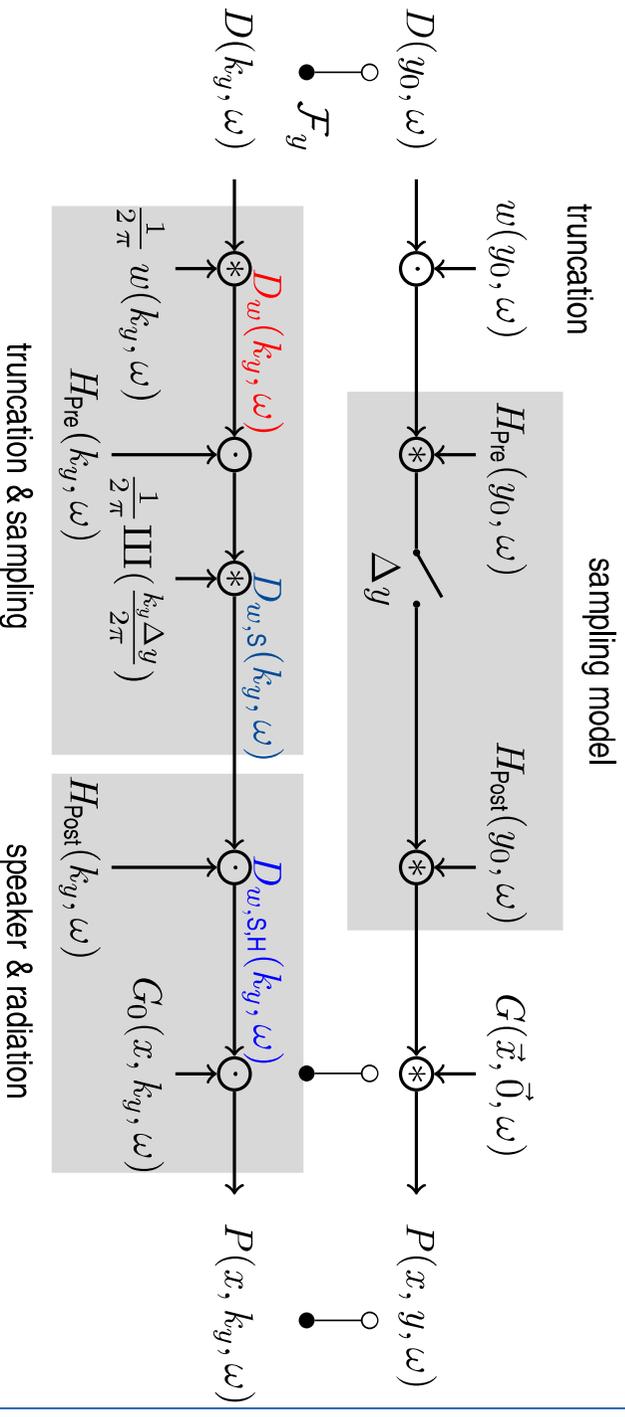


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Conclusion



slides of this talk available @ <http://spatialaudio.net/>