AUTOFOCUSING IN LOSSY MEDIA

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The problem

Autofocusing \rightarrow \text{Virtual source}
\text{Imaging using multiples}
The problem

Autofocusing + Attenuation → Virtual source
Imaging using multiples
Always present in real systems
The problem

Autofocusing + Attenuation = Convergence

Virtual source
Imaging using multiples
Always present in real systems
Unfocused solution
Convergence of the algorithm

Impulse response experiment

1-D media

1-D wave propagation
Convergence of the algorithm

Impulse response
Convergence of the algorithm

LOSSLESS medium

Focusing
Convergence of the algorithm

LOSSLESS medium

Focusing
Convergence of the algorithm

LOSSY medium

Unfocused solution
Convergence of the algorithm

LOSSY medium

Unfocused solution

Depth (mm)
Convergence of the algorithm

LOSSY medium

Unfocused solution
The indistinguishability problem

Impulse response experiment

1-D media

1-D wave propagation
The indistinguishability problem

Impulse response

Time (ms)
The indistinguishability problem

Impulse response

Lossy?

Lossless?
The indistinguishability problem

We can not know!
The idea of focusing

Needs time reversal symmetry
The idea of focusing

Needs time reversal symmetry

Attenuation: breaks symmetry
(energy loss)
The idea of focusing

Needs time reversal symmetry

Attenuation: breaks symmetry (energy loss)

Correction function: recover time reversal symmetry (energy recovery)
Focusing correction

Corrected response

= 

Lossy response \ast \text{ Correcting function}

\[ P_c(t) = P(t)e^{2\alpha t} \]
Focusing correction

Impulse response experiment

1-D media

1-D wave propagation
Focusing correction

Impulse response
Focusing correction

Uncorrected

Corrected

Depth (mm)
Focusing correction

Uncorrected
Corrected

Depth (mm)
Focusing correction

Uncorrected
Corrected

Depth (mm)
Focusing correction

Uncorrected
Corrected

Depth (mm)
Looking forward

Other corrections for attenuation
Looking forward

Other corrections for attenuation

Higher dimensions
Looking forward

Other corrections for attenuation

Higher dimensions

Characterize attenuation using focusing
GRACIAS! (Thank you)