Technical Detail

- **Start from known material**
- **Make comparisons**
- **Go extremely slowly**
- **Repeat, repeat, repeat**

One-way wave propagation

Acoustic Wave Equation

$$\frac{1}{c^2}\partial_t^2 u - \triangle u = f$$

Identify everything on your slides.

$\triangle$ - Laplacian

One-way wave propagation

First-order system

$$\partial_z \begin{pmatrix} u \\ \partial_z u \end{pmatrix} = \begin{pmatrix} 0 & 1 \\ -A & 0 \end{pmatrix} \begin{pmatrix} u \\ \partial_z u \end{pmatrix} + \begin{pmatrix} 0 \\ f \end{pmatrix}$$

$$A = \frac{1}{c^2}\partial_t^2 - \partial_x^2 - \partial_y^2$$

In a paper I might leave out this step.

One-way wave propagation

Diagonalize

$$\partial_z \begin{pmatrix} \mathbf{u}_+ \\ \mathbf{u}_- \end{pmatrix} = \begin{pmatrix} \mathbf{B} & 0 \\ 0 & -\mathbf{B} \end{pmatrix} \begin{pmatrix} \mathbf{u}_+ \\ \mathbf{u}_- \end{pmatrix} + \begin{pmatrix} \mathbf{f}_+ \\ \mathbf{f}_- \end{pmatrix}$$

$+ \quad \Uparrow$ **and** $- \quad \Downarrow$

$\pm$ **B eigenvalues**

One-way wave propagation

leave out the details

- B are ΨDOs
- only OK for high-f
- relationship between $\begin{pmatrix} \mathbf{u}_+ \\ \mathbf{u}_- \end{pmatrix}$ and $\begin{pmatrix} \mathbf{u} \\ \partial_z \mathbf{u} \end{pmatrix}$
- lose horizontal propagation
- faster to code than full-wave
- implement in parallel
- implement in frequency domain
- coupling up and down
- variable c a problem
- order of approximation