Exercise 1a of the Lecture "Full waveform inversion"

Absorbing boundary condition

16.11.2021

Introduction

At the edges of the numerical mesh the waves are totally reflected and propagate back into the model region of interest where the may interfere with the primary wavefield. The amplitudes of the artificial boundary reflection can be reduced by various methods. Here we apply a taper function which is applied at every time step, i.e. the amplitudes are gradually reduced in a strip of nodes surrounding the model region of interest. We apply a taper function which has first been suggested by (Cerjan et al., 1985).

Taper function

The taper function applied to the pressure field inside of the absorbing frame is given by

$$G(i) = \exp\left(-a^2(FW-i)^2\right), \quad a = \sqrt{\frac{\ln(1-\frac{D}{100})}{(FW-1)^2}} \tag{1}$$

where D denotes the damping factor in per cent and FW the width of the absorbing frame in grid points.
The taper is applied by multiplying the wave field with G after each time step

$$p_i^{n+1} = p_i^{n+1} \cdot G(i) \tag{2}$$

where p denotes the pressure field, n and i are the grid indices for time and space, respectively.

Tasks

1. Plot the taper function in equation 1 between i=1 and i=FW=20. Choose D=8 per cent. (5 points)

2. Implement the taper function into your 2D acoustic modelling algorithm (10 points).
3. Test the efficiency of the absorbing frame for a) FW=5, 10, 20, 40 for D=8 per cent, and b) D=2, 4, 8, 16, 32 per cent for FW=20. (20 points)
4. Discuss the optimal choice of FW and D. (5 points)

Reports and scripts

Name your report (in pdf format) as "exercise1_YN.pdf" where YN is your name. Send it to thomas.bohlen@kit.edu before the end of **30. Nov. 2021**.

References

Cerjan, C., Kosloff, D., Kosloff, R., and Reshef, M. (1985). A nonreflecting boundary condition for discrete acoustic and elastic wave equations. *Geophysics*, 50:705–708.