Seismic Waves: Exercise 8

In the lecture, the reflection coefficient R and the transmission coefficient T at a planar interface between two fluid media were derived to be

$$R = \frac{\rho_2\,\alpha_2\cos\varphi_1 - \rho_1\,\alpha_1\cos\varphi_2}{\rho_2\,\alpha_2\cos\varphi_1 + \rho_1\,\alpha_1\cos\varphi_2}$$

and

$$T = \frac{2\,\rho_1\,\alpha_1\cos\varphi_1}{\rho_2\,\alpha_2\cos\varphi_1 + \rho_1\,\alpha_1\cos\varphi_2} \quad ,$$

where

- α_1 is the velocity of the incident and reflected compressional wave in medium 1,
- ρ_1 is the density in medium 1,
- φ_1 is the incidence angle equal to the reflection angle,
- α_2 is the velocity of the transmitted compressional wave in medium 2,
- ρ_2 is the density in medium 2,
- φ_2 is the transmission angle, which follows from Snell's law, i.e.,

$$\frac{\sin\varphi_1}{\alpha_1} = \frac{\sin\varphi_2}{\alpha_2} \quad .$$

Calculate and plot R and T for $0^\circ \leq \varphi_1 \leq 90^\circ$ and

- $\alpha_1 = 4\,\mathrm{km/s}$,
- $\rho_1 = 1000\,\mathrm{kg/m^3}$,
- $\alpha_2 = 5\,\mathrm{km/s}$,
- $\rho_2 = 2000\,\mathrm{kg/m^3}$.

Keep in mind that $\cos\varphi_2$ becomes imaginary for overcritical incidence with $\varphi_1 > \varphi^*$, where

$$\sin\varphi^* = \frac{\alpha_2}{\alpha_1} \quad ,$$

such that the plot needs to include the absolute value and argument of R and T.

Discuss your results.