Scattering at an Interface

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1 Zoeppritz Equations

When a seismic wave impinges on an flat interface some of the energy is transmitted into the layer below and sme of the energy is reflected back. The relative proportion of energy converted into different aspects of P and S-wave can be decribed by a set of equations set forth in the classic text book by Aki and Richards [**?**]Aki2002). Zoeppritz are also known as Knott's Equations.

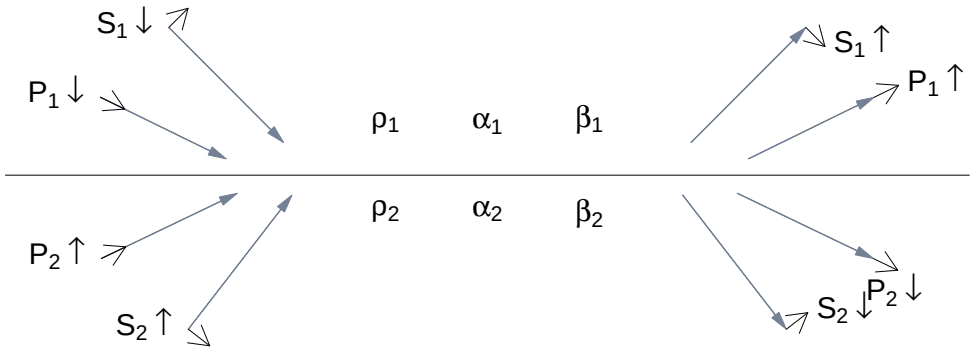

Figure 1: Figure from Aki and Richards showing incoming P and SV waves to the interface.

To calculate the associated matrix of incoming and outgoing amplitudes with different incident angles, first we set up the velocity model at the interface. These are the α, β, ρ illustrated in figure 1 above and below the interface.

```
library(zoeppritz)
##############   set up a velocity model
### layer 1:

alpha1 = 4.98
  beta1 =  2.9
   rho1 = 2.667
##########  layer 2
  alpha2 = 8.0
   beta2 = 4.6
   rho2 = 3.38
```

Then the program is called that calculates the scattering coefficients and plots the result:

```
App =  pzoeppritz( "Amplitude" , alpha1, alpha2, beta1,
  beta2, rho1 ,rho2, "P", "ALL");
```

```
dev.off()
```

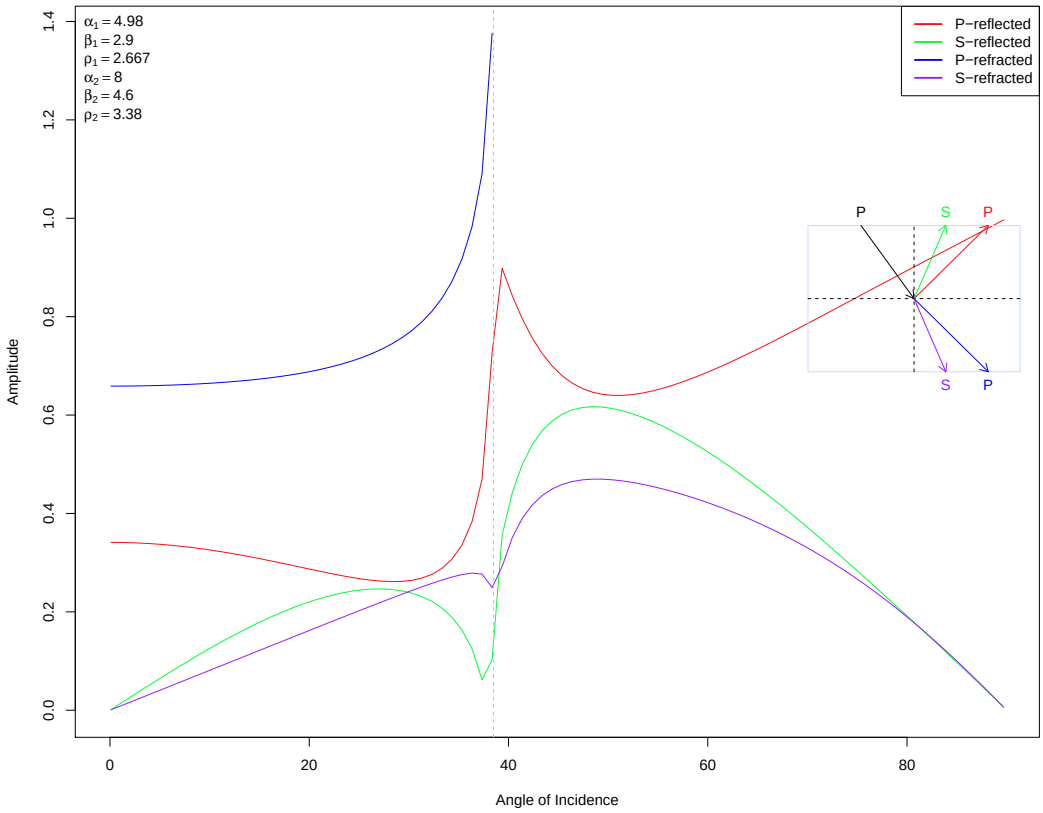

Figure 2: P-wave incoming, show all the outgoing amplitudes.

Next we change the outgoing waves to S-waves:

Incident wave in high velocity layer

```
alpha1 = 8.0
 beta1 =  4.6
  rho1 = 3.38
```

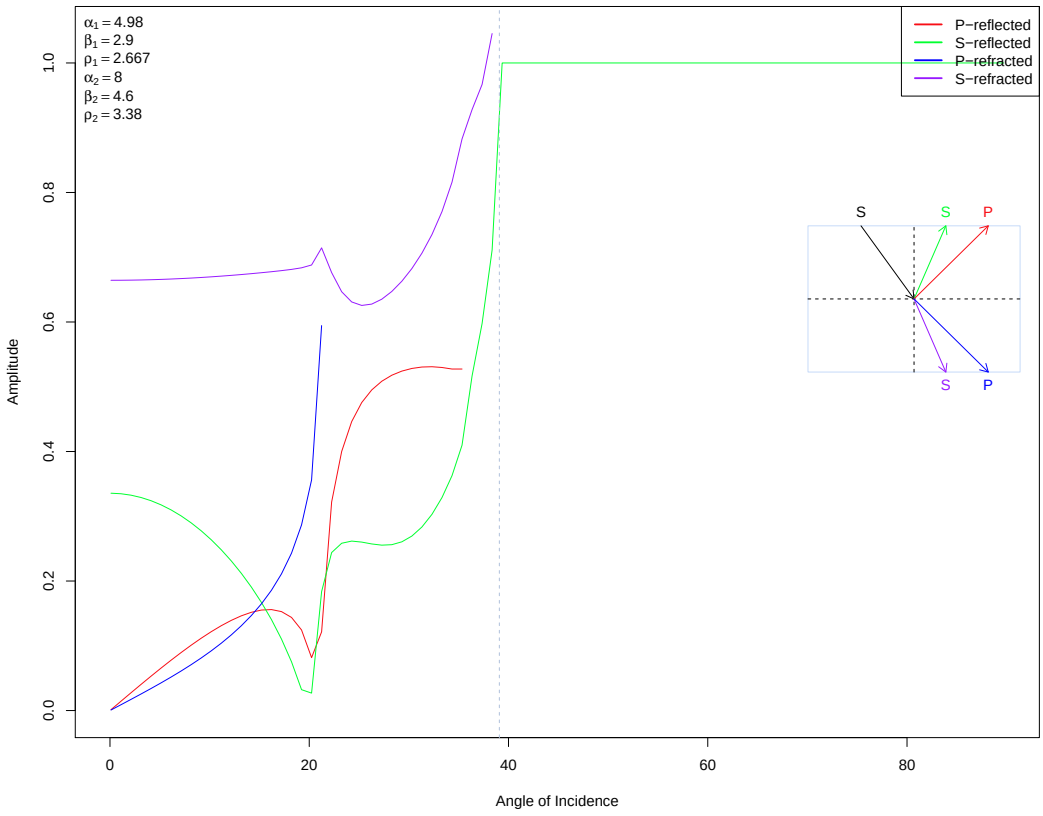

Figure 3: S-wave incoming, show all the outgoing amplitudes.

```
############
  alpha2 = 4.98
   beta2 = 2.9
   rho2 = 2.667



 App =  pzoeppritz( "Amplitude" , alpha1, alpha2, beta1,
   beta2, rho1 ,rho2, "P", "ALL");
```

Next we change the outgoing waves to S-waves:

```
############  change incoming wave to S-wave:
App =  pzoeppritz( "Amplitude" , alpha1, alpha2, beta1,
  beta2, rho1 ,rho2, "S", "ALL");
```

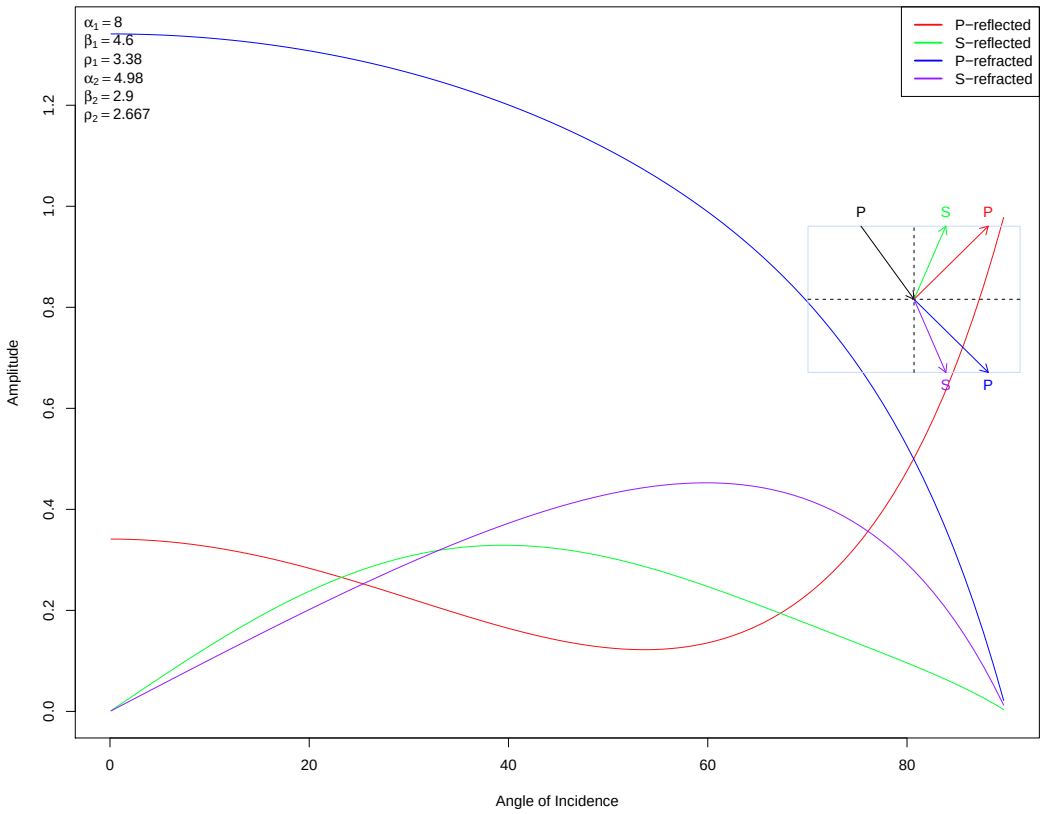

Figure 4: High velocity above low velocity. P-wave incoming, show all the outgoing amplitudes.

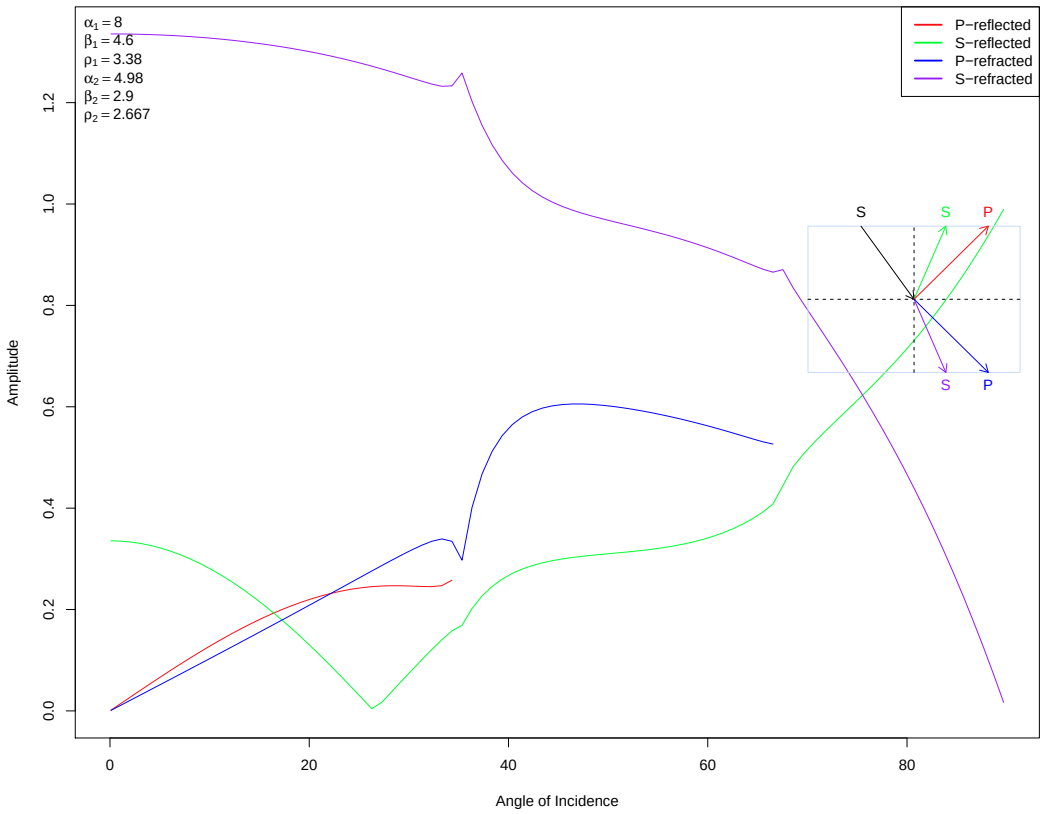

Figure 5: High velocity above low velocity. S-wave incoming, show all the outgoing amplitudes.