

The Matlab script `run_rimLG.m` runs the computational function `rimLG` and computes the range independent modal (rim) acoustic field using the Legendre-Galerkin method. The method is described in the document `Legendre_Galerkin_Dec5_16.pdf`.

To run `rimLG`, type `run_rimLG` at the Matlab prompt in the directory containing `rimLG` and the other supporting files. The generic input file is `rimLG.dat`. The script `run_rimLG` invokes the Matlab editor so that the user can make changes to `rimLG.dat` for the desired calculation. `rimLG.dat` contains the parameters defining the modal calculation. These include: frequency(Hz), source depth(m), receiver depths(m), receiver ranges(km), number of modes to compute (even), and number to use in the modal sums. There are also tables of environmental parameter. Their units are `dep(m)`, `svp(m/s)`, `dbpwl(dB/wavelength)` and `rho(gm/cm^3)`. There are two tables: one for the water and one for the bottom sediment, with NW and NB points in each. It is necessary that `depw(NW)=depb(1)` where the density usually has a discontinuity. The first entry `depw(1)=0` is the free surface. The last entry `depb(NB)` determines the total thickness of the waveguide and is also a free surface. An absorbing layer is usually used at the bottom of the sediment to prevent reflection from the boundary at `depb(NB)`. See the following example:

If the Matlab editor tries to share the command window, click the down arrow in the editor tool bar and select "undock." Here is an annotated excerpt from `rimLG.dat`. See the full `rimLG.dat` that comes with the code for other examples. % Matlab does not allow inline annotations so the part of `rimLG.dat`, read by Matlab, can not contain the '!' annotations.

```
Mixed Layer and Attenuation Gradient Example !case name
250.0 50.0 !frequency(Hz), source depth (m)
198 100 !M # of Modes (even), MS # to Sum(MS<=M)
200 2.0 2.0 !NDEP,# of Receiver depths, minimum, and increment (m)
0.01 5.01 .01 ![Receiver range interval], and increment (km)
4 2 !NW in water, NB in sediment
0.0 1520.0 .0 1.00 !depw,svpw,dbpwlw,rhow (1:NW)
20.0 1520.0 .0 1.00
30.0 1480.0 .0 1.00
200.0 1480.0 .0 1.00
200.0 1600.0 .05 1.50 !depb,svpb,dbpwlb,rhob (1:NB)
1000.0 2000.0 .20 1.50
```

Any changes to `rimLG.dat` should be saved in the editor to reflect the parameters of the desired calculation. The Matlab command window is paused for the editing.

After saving the parameters of the desired calculation in the editor, one should click in the Matlab command window to proceed with the calculation. After answering a couple of 'y' or 'n' questions, the calculation starts. When the calculation is completed, the results can be plotted. The plots (in order) show the complex horizontal wave numbers, selected normal modes, a grayscale plot of the acoustic transmission loss field, and a line plot of the transmission loss at a fixed receiver depth. Detailed plots of modes and the acoustic field versus depth require the specification of many receivers spanning the depth interval of interest.

The script run_rimLG also writes a generic transmission loss file rimLG.tl containing all the receiver depths. The complex acoustic pressure field is returned by rimLG and could be saved and used in other calculations.

Below is a copy of a typical dialog, in the Matlab command window. The lines in angular brackets do not appear in the command window dialog. The section including <edit rimLG.dat> is repeated until all changes are saved. The dialog generated four plots after positive responses to request from the script. The locations, in the dialog, where the plots occur are indicated by <Fig. 1>, <Fig. 2>, <Fig. 3>, and <Fig. 4>. The sections including <Fig. 2> and <Fig. 4> are repeated, with increasing figure numbers, if more plots are requested. Some plots require additional input from the user. The title for each of the plots is the case_name on the first line of rimLG.dat. The dialog starts and ends with the command window prompt >>.

```
>> run_rimLG
Starts by opening rimLG.dat in the editor
Press any key to continue

Make changes to rimLG.dat, if any.
Save rimLG.dat for the desired calculation.
<edit rimLG.dat>
*** Click in the command window and press any key to continue ***
Have any required changes been saved? y/n :y

You may close the editor now.

Do you want to run rimLG? y/n :y
rimLG calculation started: please wait.
<Should take about a minute.>
rimLG calculation completed.
Do you want to plot the wave numbers? y/n :y
<Fig. 1>
Do you want to plot a mode? y/n :y
What mode number do you want to plot?:13
Mode plot started.
<Fig. 2>
Do you want to plot another mode? y/n :n
Transmission loss calculation started.
Transmission loss calculation completed.
Do you want to plot the acoustic field? y/n :y
What min loss (dB) do you want to plot?:40
What max loss (dB) do you want to plot?:100
<Fig. 3>
Do you want to plot loss vrs. range? y/n :y
What receiver depth (m) do you want to plot?:100
<Fig. 4>
Do you want to plot another receiver? y/n :n
>>
```

The plots resulting from the above dialog are as follows:

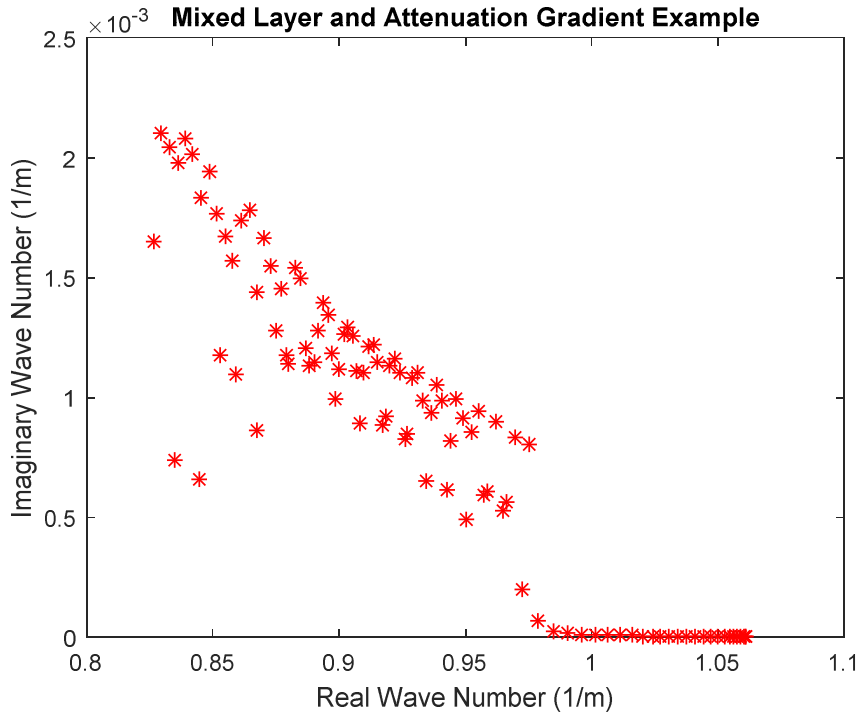


Figure 1. Complex horizontal wave numbers

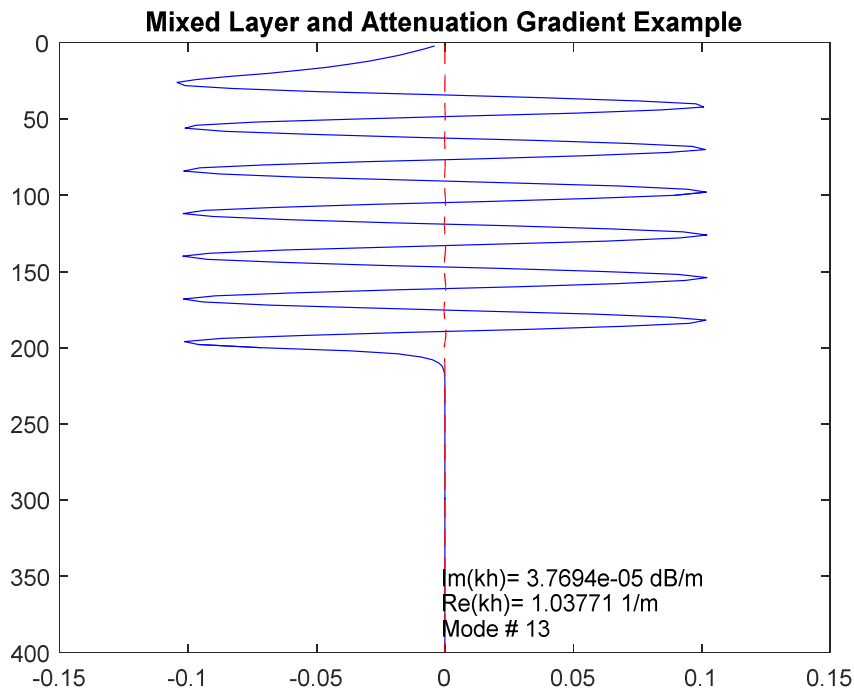


Figure 2. Mode number 13 versus depth in the first 400 meters.

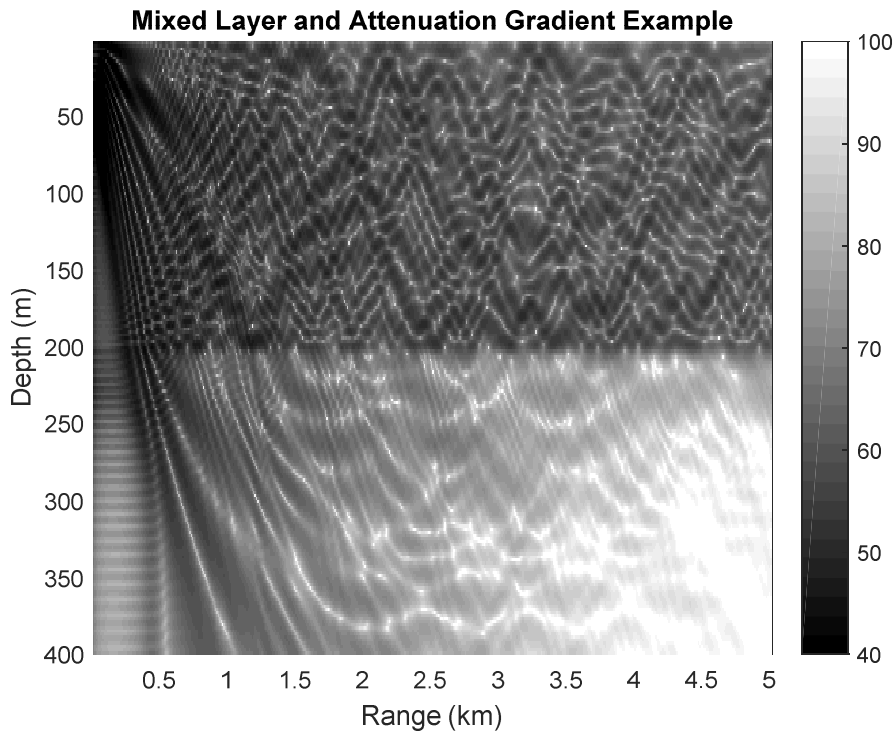


Figure 3. A grayscale plot of transmission loss versus range and depth.

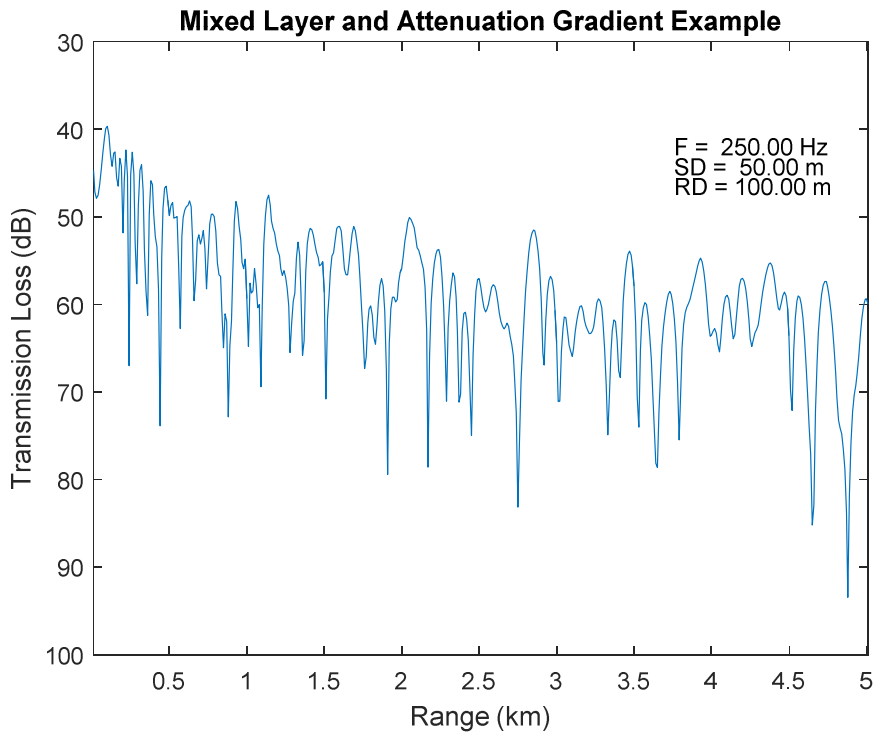


Figure 4. Transmission loss versus range for a receiver at a depth of 100 meters.

Comment: After a plot is requested and a figure is displayed, the command window will be partially obscured. In this situation, an inadvertent key stroke can result in an un-appropriate answer to the next question. To avoid an abnormal termination, click in the command window, bringing it back to the foreground, and continue with other plots as needed. All the figures will remain active in the background and can be reviewed after the script has terminated normally.

List of files or scripts used by the rimLG:

rimLG.dat: Input data file for rimLG

rimLG.tl: Output transmission loss file from rimLG

run_rimLG.m: Matlab script that reads rimLG.dat and calls rimLG.m to compute the acoustic field

rimLG.m: Main computational function that calls table_gen, abmat, csrt, basic_depth_fct and the Matlab function 'eig'

table_gen.m: Generates tables of complex index of refraction

csrt.m: Complex square root with a positive imaginary part

abmat.m: Generates matrices A and B by calling 'legpts' and 'legpoly'

legpts.m: Generates quadrature points and weights for Gauss-Legendre integration from Chebfun

legpoly.m: Evaluates Legendre polynomials and their derivatives by Zoltan Csati

basic_depth_fct.m: Evaluates functions in the Legendre polynomial spanning set at depth Z

pkh_plot: Plots complex horizontal wave numbers

mode_plot: Plots selected normal modes

fld_plot: Plots the acoustic (transmission loss) field versus range and depth

tl_plot: Plots transmission loss versus range for a selected receiver depth