Palmer 2010 Syncline Model construction and forward modeling, with Rayfract® 3.18 and Golden Software Surfer® 8

We show how to define the recording geometry by importing dummy shots into a Rayfract® profile database, without first break picks. Next we create a syncline model grid with Surfer, as in Palmer 2010 Fig. 5. Then we generate synthetic shots with our Eikonal Solver, by forward modeling wave propagation through this model grid. For inversion of these synthetic data see http://rayfract.com/tutorials/fig9inv.pdf .

Create a new Rayfract® profile database, import dummy shots

Download archive PALMFIG9.ZIP containing file ONESHOT.ASC from our web site :

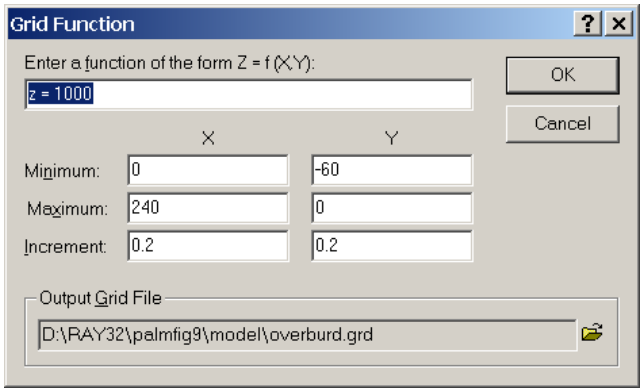
http://rayfract.com/tutorials/palmfig9.zip .

Now create new profile database named PALMFIG9, as described in our manual available at http://rayfract.com/help/manual.pdf . Specify *station spacing* of 5m, in *Header|Profile*. Copy above file ONESHOT.ASC into directory \RAY32\PALMFIG9\INPUT. ONESHOT.ASC specifies 49 channels, with first breaks set to -1. You may edit such a dummy .ASC shot with any text editor e.g. Windows WordPad.

Now import file ONESHOT.ASC repeatedly, once for each shot position which we want to model, as in above manual.pdf . Specify *Import data type* ASCII column format. Leave *Default spread type* at default setting 10: 360 channels. Specify *Shot pos. [station no.]* 0, 6, 12, 18, 24, 30, 36, 42, 48 as in Palmer 2010 Fig. 8. Specify *Shot Number* 1 to 9 for these shots, during import. Leave *Layout start* at 0.0 .Once done with import, set topography elevation "z" to 0.0 in *Header|Station* for one station. Hit ENTER and confirm prompt, to extrapolate elevation 0.0 to all stations.

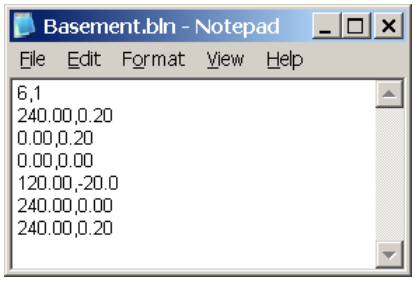
Build model grid file with Surfer 8

Start up Surfer 8. Select *File|New* and choose *Plot Document*, then click OK. Now select *Grid|Function...* and specify the parameters for generation of our overburden grid as follows :



Click on OK to generate our constant-velocity overburden grid file. Select *Grid|Function...* again and set the "function" text field to "z = 2820". Specify \RAY32\PALMFIG9\MODEL\BASEMENT.GRD for *Output Grid File*. Click on OK to generate the constant-velocity basement grid file.

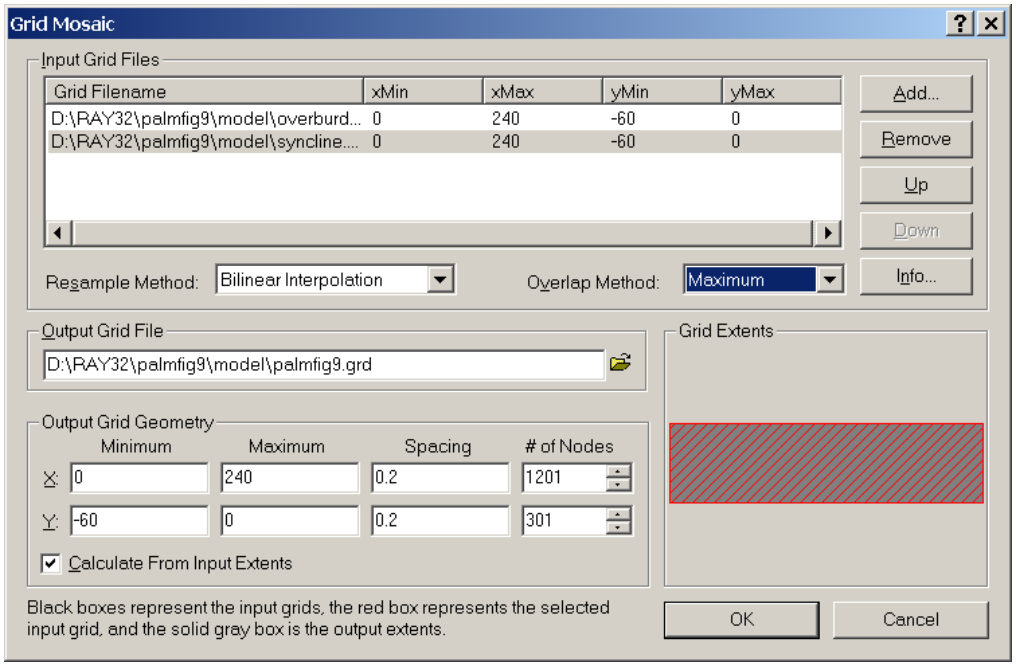
Next we edit a *blanking file,* with any text editor. Select *Start|Run...,* enter the program name NOTEPAD.EXE and hit RETURN. Then enter the following content :



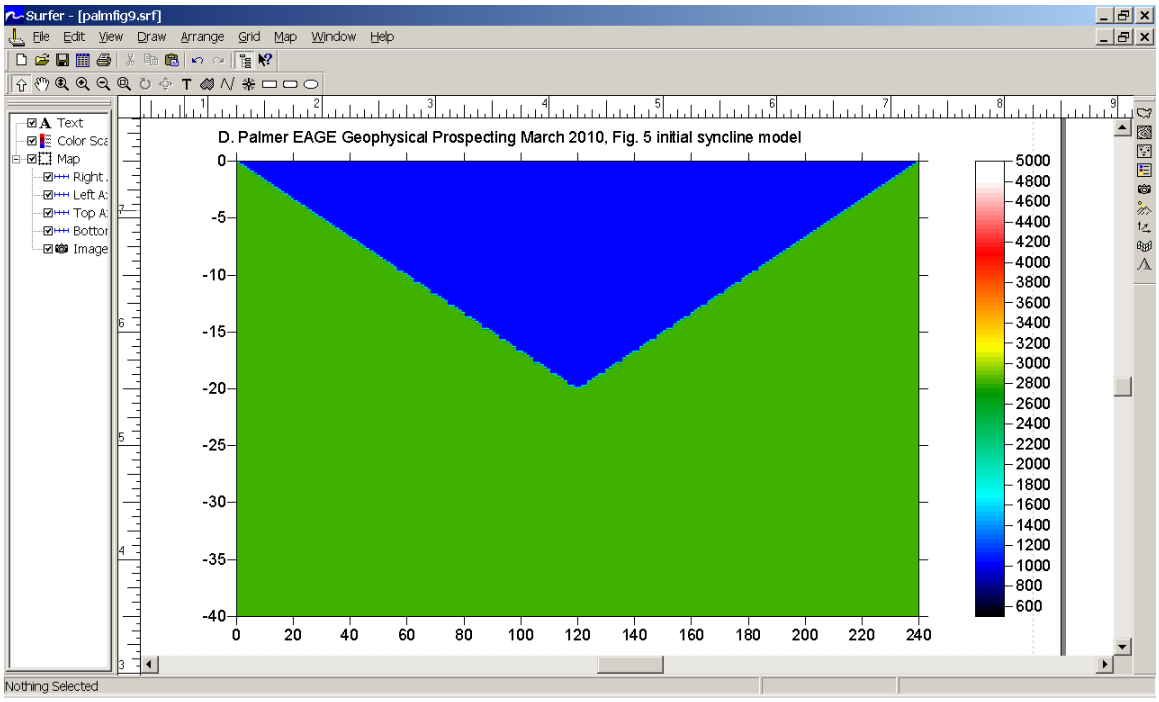
Be sure to hit ENTER at end of last line 240.00, 0.20, to force an end-of-line character in the disk file. Select *File|Save As...* . Set *Save as type* to *All Files*. Set *File name* to BASEMENT.BLN. Click on *Save button*. This file is a *Golden Software Blanking File*; see your Surfer 8 manual Appendix C. Our blanking file describes the "syncline" triangular polygon which we want to cut out of above basement grid file. The lower side of the polygon is the "top of basement" topography i.e. relief.

Go back into Surfer, select *Grid|Blank...* and then the BASEMENT.GRD file as generated above. Then select our BASEMENT.BLN file. Specify \RAY32\PALMFIG9\MODEL\SYNCLINE.GRD as output file name and click on Save to generate our "basement with syncline" grid file.

Now we add our constant-velocity overburden to the syncline model. Select *Grid|Mosaic...* and then above OVERBURD.GRD file. Click on Add... and select above SYNCLINE.GRD file. Set *Overlap method* to *Maximum*. Click on the folder icon to the right of field *Output Grid File* and enter file name PALMFIG9.GRD. Our *Grid Mosaic dialog* should now look as follows :



Click on OK to generate the final syncline model. Select *Map|Image Map…* and our PALMFIG9.GRD file. Double-click the resulting plot with left mouse key. Click on *Colors bar* in *General tab*, and load *Color scale* \RAY32\RAINBOW2.CLR. In frame *Data to Color Mapping*, set *Minimum* to 500, and *Maximum* to 5000. Adapt *Limits and Scale tabs* to obtain this output :



Forward model seismic body wave propagation through syncline model

Open profile database \RAY32\PALMFIG9 as created above, with Rayfract® *File|Open Profile…* Select *Model|Model synthetic shots…* and \RAY32\PALMFIG9\MODEL\PALMFIG9.GRD . Select *File|Export header data|Export First Breaks as ASCII…* . Save to file PALMFIG9.ASC. Select *Refractor|Shot breaks*. Now press ALT+P, set *Maximum time [msecs*.] to 90 and hit ENTER. Compare the traveltimes as shown below to Palmer 2010 Fig. 8; these data are identical. For inversion of these synthetic data see http://rayfract.com/tutorials/fig9inv.pdf .