CHAPTER 5

Conclusions

5.1 Conclusions

The full waveform inversion method and its capabilities when applied to a complex geological structure, such as Marmousi model has been presented in this study. It performs an iterative update the velocity model that minimises the misfit function or the difference between the observed data and the generated data from current velocity model. The whole recorded wave field is being used as an input data for FWI computations. The FWI, in this study are implementing in the time domain, taking the advantage for FWI can include all available frequencies for inversion.

Using the gradient method for FWI, the model perturbation estimation is based on the gradient of misfit function. The calculation of the gradient of misfit function has been demonstrated in this study as a zero-lag cross-correlation between residual data and partial derivative wavefield which is the most time consuming process in FWI workflow.

In this study, the FWI was applied to a sub-part of the Marmousi model, of 3220m long and 1000m depth. The inversion result when using a smoothed version of the true velocity model as initial model is very satisfying. The overall structure are precisely delineated and updated to the velocity model. A detail of the velocity variation on lateral and vertical has been recovered with respectively increasing of the number of iterations. Comparing the latest updated velocity (20th iteration) with the true velocity, the result indicates that the updated velocity is slightly lower than the true model implies that more iterations of inversion are needed to refining the model.

Investigation of the limitation of the full waveform inversion indicates that the FWI technique can be recovered a detail of velocity with an accuracy of half of the wavelength of the seismic wave, which is demonstrated in this study that the layer has thickness more than half of the wavelength FWI can precisely recover and update the model. However, for the layer that has thickness less than this limit, FWI still can detect the existing of thin layer but not accurately determine the boundary of that thin layer.

In this study, detail and accurate velocity model was derived by FWI. It has been proven as a very interesting method for complex structure imaging. The result indicates that it has a potential for estimating complex velocity model and it is a possible tool for obtaining a high-resolution imaging.

5.2 Future work

For future testing of FWI, the more effort can be spent on recovery the detail of the velocity in the deeper part which the result, in this study shows that applying only a constant scaling is not sufficient. A variable scale or amplitude preconditioning, such as Hessian matrix, should be considered which will demand a lot more computer power.

Applying the method to the real dataset would be very interesting, and the FWI code should be expanded to include 3-D wave propagation and inversion. Moreover, a multi-parameter FWI is also very attractive topic which is invert not only the velocity but taking a density model as part of the amplitude mismatching.