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Acoustic Impedance Inversion of Seismic Data Using Genetic Algorithm

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The inversion of seismic data can be used to constrain estimates of the Earth's acoustic impedance structure. This kind of problem is usually known to be non-linear, high-dimensional, with a complex search space which may be riddled with many local minima, and results in irregular objective functions. We investigate here the performance and the application of a genetic algorithm, in the inversion of seismic data. The proposed algorithm has the advantage of being easily implemented without getting stuck in local minima. The effects of population size, Elitism strategy, uniform cross-over and lower mutation are examined. The optimum solution parameters and performance were decided as a function of the testing error convergence with respect to the generation number. To calculate the fitness function, we used L2 norm of the sample-to-sample difference between the reference and the inverted trace. The cross-over probability is of 0.9-0.95 and mutation has been tested at 0.01 probability.
The application of such a genetic algorithm to synthetic data shows that the inverted acoustic impedance section was efficient.

Keywords: Seismic, Inversion, acoustic impedance, genetic algorithm, fitness functions, cross-over, mutation.