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# Goodbye Noise, Hello Signal! Improving Microseismic Monitoring in Noisy Environments

F.H. Kindy* (PDO), G. Engen (PDO), I. Ismaily (PDO), N. Touqi (PDO) & A. Yahyai (PDO)

## SUMMARY

Over the last decade, Petroleum Development of Oman have deployed several microseismic monitoring systems. Due to the maturity of many of the oilfields in Oman, anthropogenic noise is in abundance. Given that the magnitude of some of the microseismic events can be as low as M = -3, noise can seriously hamper the detection and/or processing of such events. This paper describes PDO's experiments on new hardware and software to increase S/N. We show some examples of how our implementaion techniques improved event detection thresholds. In addition, we propose simple solutions that are not only more effective at noise reduction, but are also cheaper both in implementation and in reducing the subsequent cost of data processing.

Over the last decade, Petroleum Development of Oman have deployed several microseismic monitoring systems, These mainly consist of permanent downhole geophones cemented in dedicated observation wells to help monitor processes such as water and steam injection or caprock integrity.

However, due to the maturity of many of the oilfields in Oman, anthropogenic noise is in abundance. Sources of such noise include surface noise (trucks, construction etc.), electrical noise from cables, logging, cathodic protection (Figure 1 and 2) and production noise from injectors and producers. Given that the magnitude of some of the microseismic events can be as low as M = -3, noise can seriously hamper the detection and/or processing of such events.

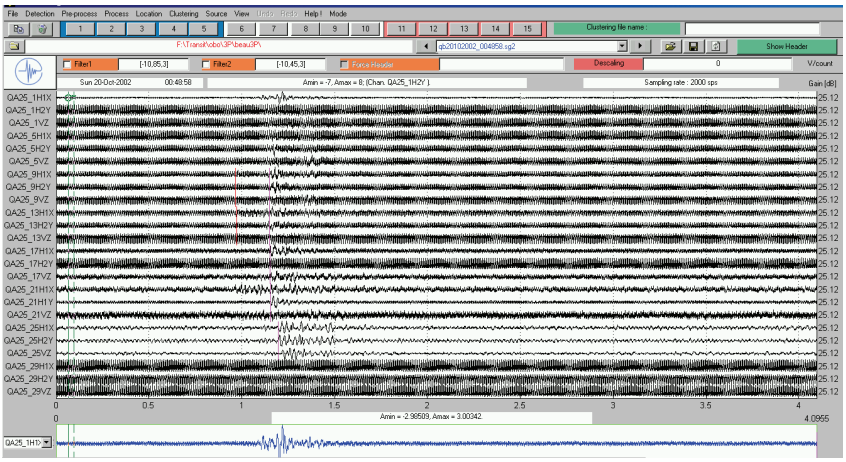

*Figure 1: Strong electrical noise in microseismic data hampers processing.*

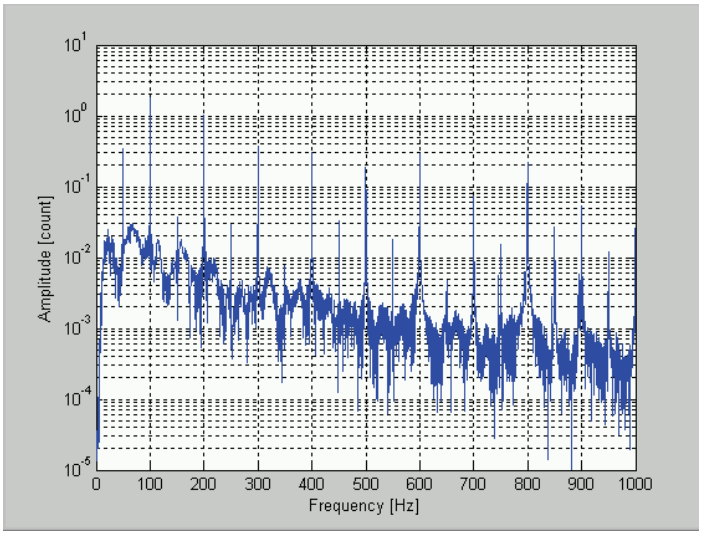


*Figure 2: power-spectra of microseismic signal showing strong electrical noise with harmonics.*

Due to these issues, PDO have been using as well as experimenting with different 'hardware' and 'software' solutions to reduce / eliminate noise and/or to improve the detected signal quality. These are summarised as follows:

| Hardware | Benefits |
|---|---|
| Wireless data transfer, Solar power supply, electrical earthing and shielded cables | Together, these reduce ambient electrical noise pick-up and risk of cable damage (signal leakage) |
| Observation well locations and design | Cemented geophones give much better coupling with rock matrix which improves signal amplitude. Using more geophones can also improve event detection |
| Improved geophone element configuration and specifications | By optimising the type and number of phone elements used per geophone component, the sensitivity of the system can be increased |
| **Software** | **Benefits** |
| Pre-trigger lag filtering | Done in real time, can considerably reduce number of 'false' events in areas of high electrical noise |
| Post-trigger filtering and processing | Many techniques available that can vastly improve the number of picked events |

In this paper we show some examples of how techniques such as those in the table above can reduce noise or improve event detection thresholds. In addition, we propose simple solutions that are not only more effective at noise reduction, but are also cheaper both in implementation and in reducing the subsequent cost of data processing.