



Application Note



ACMT - ADASH Compressed Time

A new diagnostic method for bearings on slow speed machinery

Application:

📁 Diagnostics of low-speed machines – paper machines, rolling mills, transport mechanisms...

In slow speed machinery there are various processes which produce short duration pulses. These are often caused by rolling element bearings, gearbox wear, etc. It is important to be able to accurately detect, measure and analyse these pulses for correct diagnosis of these defects.

The individual pulses can be very short duration, consequently it is necessary to set a high sampling rate for measurement. Only in this way is it possible to obtain a correct indication of amplitude of these pulses.

The pulse frequency will vary and depend on the shaft running speed. For slow-speed machines a long time interval between pulses (approximately few seconds) is to be expected. For correct analysis of a short pulse, knowledge of the frequency is critical. This information is needed to locate the source of the machine's problem.

These two aspects produce a conflict in the measurement method:

1. We need measure with a high frequency sampling, that means the measured signal will very short e.g. 100ms. If we measure with a long time period e.g. 3s, there is minimal chance to capture a short pulse. If one pulse is captured by chance, there is still no way to be able to analyse the period, since this pulse could be some other occasional effect.
2. We need a long time record e.g. 10s to establish correct determination of pulse frequency. We must choose a low sampling rate, but again we can capture a short pulse only by chance, because it would usually be filtered out by an anti-aliasing filter. If one pulse is captured by chance, there will still be no way to analyse the period. Our results will depend on chance too.

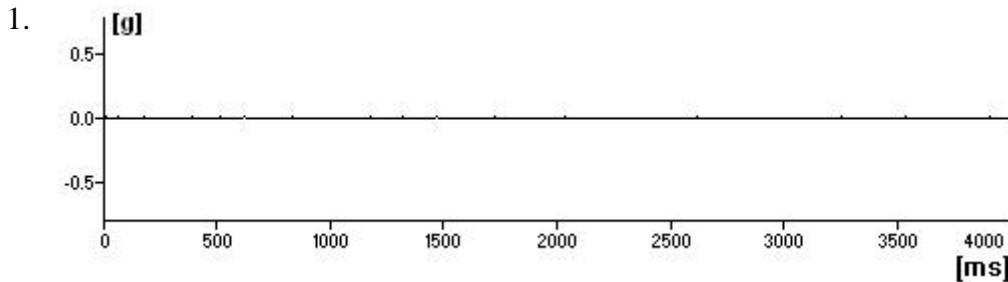
The ADASH Compressed Time (ACMT) method offers a solution to this problem.

This method implements both contradictory requests by double sampling the data. First, a high sampling rate signal is acquired to detect the short time processes and then the signal is re-sampled with a low sampling rate (long time record). Finally, the processing performs data compression of the low-level part of signal.

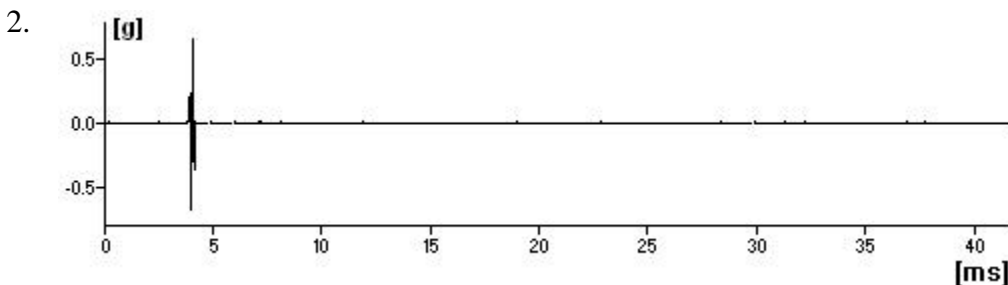
An example comparing measurement by the standard time method and by the special ACMT method is on the pictures below.

All measurements were taken on a slow-speed 23132-TOR rolling bearing rotating at 60 rpm (1 Hz). This bearing had an outer race defect, caused by careless arc welding nearby resulting in current leakage through the bearing. During normal machine operation a short duration pulse was generated, caused by the rolling elements crossing the defect on the outer race.

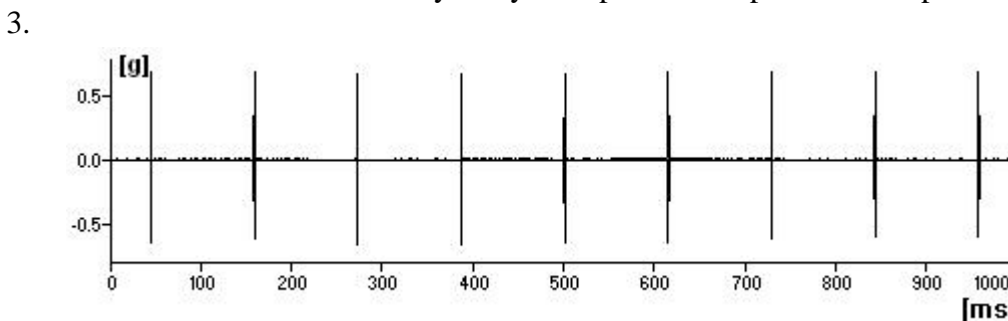
First we measure the signal using the standard time method with a record length of 4sec. For 2048 samples (standard value) this makes the maximum measurement frequency 200Hz to prevent aliasing. The resultant time signal is in pic.1 and the measurement was clearly unsuccessful. We don't see short-pulses, because they were filtered out by the anti-aliasing filter.



In the second measurement the maximum measurement frequency was increased to 19200Hz, but the record length must go down from 4s to 42ms. Because the period of the short-pulses is 114ms we have only a small chance to "hit" this. The time signal in pic.2 shows when we "hit" a pulse. If the period of the pulse were longer, then the majority of records would not find any hits. We can set more samples during measurement which will increase the chances of a hit, but this will not solve the problem of detecting long period pulses.



The final measurement was using the ACMT method. From the time signal in pic.3 it is evident that this special method has worked. In a long time record all of the short duration pulses are detected. Now we can correctly analyse amplitude and period of the pulses.

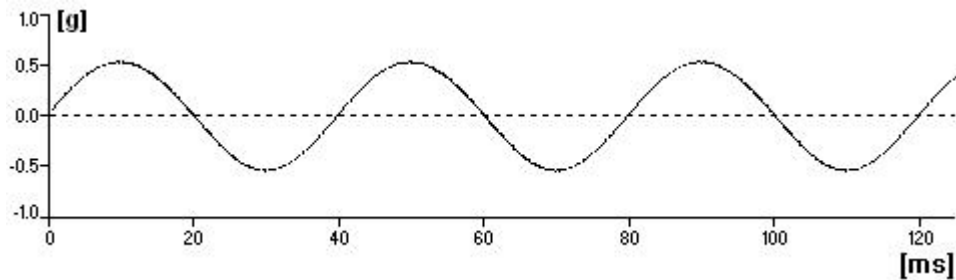


The ACMT method can do even more.

In practice such short duration pulses will have a small amplitude. They are often modulated by a low frequency (generated by running speed of machine) which has much greater amplitude.

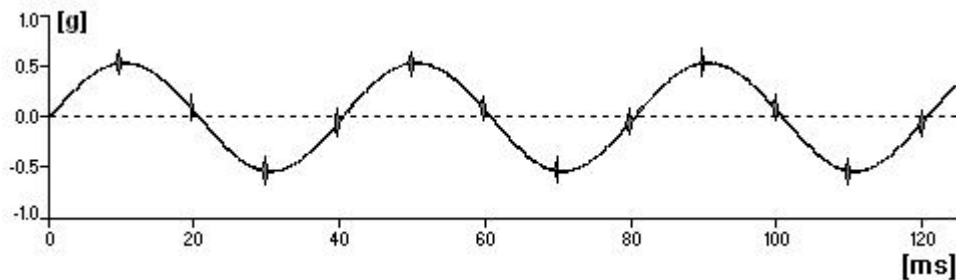
In the next series of pictures is an example of such a signal. The sinusoidal signal is from the running speed of the machine (1500rpm in this case) and is generated by an unbalanced shaft. The time signal in pic.4 indicates a measurement using the standard time method, we can see almost nothing but the sine wave without short-pulses.

4



The time signal in pic.5 is a measurement by the ACMT method. In this case the short-pulses are detected but their amplitude is modulated by the main sine wave.

5.



In the ACMT menu there are some additional settings. This allows us to filter out the low frequency sine wave to leave us with just the pulses with greater amplification and legibility. The final result is the time signal in pic.6. The short-duration pulses have been cleanly detected making their analysis much simpler.

6.

