Chapter 8
CONCLUSIONS

• The central theme of this work is the design of a high throughput data acquisition and analysis system using an array of digital signal processors. The development of AEDAPS proves that the resulting system is flexible and powerful. The proposed design unifies the waveform recorders used by researchers in wideband AE experimentation and the feature based conventional commercial AE systems.

• The development of AEDAPS has enabled us to compute a number of novel parameters for the AE event. These include the energy profile, Linear Predictive Coefficients, Signal Kurtosis, Correlation and Spectral Parameters. An evaluation data base was constructed for usage as a test bed for comparing these different parameter sets.

• The most important issue of on-line multi-channel AE-signal analysis continues to be the availability of processing power. This processing power ultimately dictates the kinds of algorithms feasible in real-time. Due to the transient and asynchronous nature of the AE activity, it is not possible to determine the event rate a-priori. The common solution to this problem is to provide enough memory buffers to capture the signals so that a short term pool is maintained to avoid signal overflow prior to processing. This method also breaks down in case of high emission at a node. AEDAPS implements dynamic re-configuration of loads on the processing nodes. In this scheme, Processors connected to sensors at passive nodes are used for sharing the processing load of active nodes.

• AEDAPS introduces the concept of flexible interconnection of the channels in a three layered hierarchical structure. At layer 1, any two channels can be brought to the same DSP. The DSPs themselves are interconnected in a hypercube topology using high speed data channels at layer 2. The channel assignment over this is flexible and hence channels with high correlation can be assigned to neighboring nodes. At the top most layer, host systems containing clusters of DSPs are interconnected over a bus. The AE data arriving at any channel may be made to pass through these computing nodes. Since the nodes are operating in parallel, the computational load is effectively distributed facilitating detailed on-line processing.

• The task decomposition in the case of the full version of AEDAPS organised in the form of a four dimensional hypercube is analysed and it is shown that dynamic re-configurations based on event rate parameter will result in a stabilised system, provided the parameter set and the digital filtering specifications are kept static.
• A method of comparing alternate parameter sets for their faithfulness to re-construction of original signal profile is proposed and based on this, it is shown that the energy profile parameter set out-performs the conventional parameter set in all the analysed classes.

• AEDAPS allows dynamic signal conditioning like FIR and IIR filters, mean / median smoothing and profile extraction prior to parameter extraction. This can be invoked in cases where the ratio of AE active period to total period is not high. A simple thumb rule exists for the limit to this ratio in terms of the sampling frequency, enabling one to determine the sampling frequency and hit lock-out time to be used in practical situations.

• The median filtering does not seem to give any particular advantage to the AE tests evaluated. However, the tests considered were all in controlled environments. It is possible that the median filter turns out to be an effective tool in situations where tight control of the environment is not feasible.

• The profile extraction based on running maximum, prior to digital filtering is found to give a smooth profile of the emission signal. This profile may be used for parameter extraction and other signal analysis.