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IT/ENG04/051
EEE 471
Elect / Elect

Questions

1. Explain briefly the signal processing and interfacing techniques in measuring instruments.

2. Explain briefly the expert system instrumentation.

Answers

1a) Signal processing can be said to be a subfield in electrical engineering focusing on analysing, modifying and synthesizing signals (ie sound and images or scientific measurements).

Signal processing is important as information contained within the signals can be displayed, analyzed or converted to another type of signal that may be of use.

In other words, signal processing is the manipulation of one (or multiple) signal(s) into a form either used for analysis or control. The signals vary from sound, light (image), temperature, acceleration e.t.c.

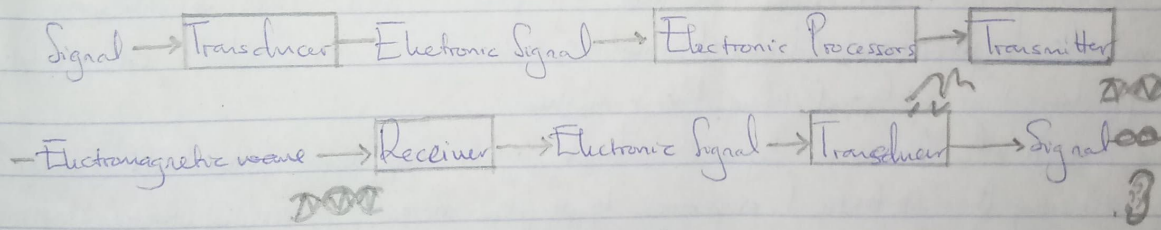

Fig 1. Signal transmission using eletronic signal processing.

b) Signal interfacing techniques are used to improve transmission, storage efficiency and subjective quality, emphasize or detect components of interest in measured signal. These techniques include

Analog: This processing is for signals which haven't been digitized (radio, television systems, radar and telephone.) This includes linear and non linear electronic circuits.

Linear circuits consist of passive filters, active filters, additive mixers, integrators and delay lines.

Nonlinear circuits contain/include comparators, multipliers (frequency mixers, voltage-controlled amplifiers), voltage-controlled filters, voltage-controlled oscillators, and phase-locked loops.

Continuous time: This is for signals that vary with the change of continuous domain. The methods of signal processing include time domain, frequency domain and complex frequency domain. It discusses the modeling of linear time-invariant continuous system, integral of the system's zero-state response, setting up system function and the continuous time filtering of deterministic signals.

Discrete time: is for sampled signals, defined only at discrete points in time and as such are quatized in time, but no magnitude. The concept of discrete-time signal processing also refers to a theoretical discipline that establishes a mathematical basis for digital signal processing, without taking quatization error into consideration.

Digital: is the processing of digitized discrete-time sampled signals. Processing is done by general-purpose computers or by digital circuits such as ASICs, field-programmable gate arrays or specialized digital signal processors (DSP chips). Typical arithmetical operations include fixed-point and floating-point, real-valued and complex-valued, multiplication and addition.

Nonlinear: This process involves the processing and analysis of signals produced from nonlinear systems and can be in the time, frequency or spatio-temporal domains. Nonlinear systems produce high complex behaviors which may include bifurcations, chaos, harmonics, and subharmonics which cannot be produced or analyzed using linear methods.

Statistical: This is an approach which treats signals as stochastic processes utilizing their statistical properties to perform signal processing tasks. Statistical techniques are widely used in signal processing applications. One can model the probability distribution of noise incurred when photographing an image and construct techniques based on this model to reduce the noise in the resulting image for example.

2 Expert System Instrumentation.

In the world of artificial intelligence (AI), an expert system is a computer system emulating the decision making ability of a human expert. This system is designed to solve complex problems by reasoning through bodies of knowledge, represented mainly as if-then rules rather than through conventional procedural code.

An expert system can be further divided into two subsystems being:

1. The inference engine - applies the rules to the known facts to deduce new facts
2. The knowledge base - represents facts and rules.

Advantages

- Makes critical information required for the system to function explicit rather than implicit.
- Rules are specified in intuitive format and understood easily.
- Rapid development (Rapid prototyping)
- Ease of maintenance.

Disadvantages

- Knowledge acquisition problems.
- Performance issues.
- Increase / Size of the knowledge base.
- Addition of new piece of knowledge