Electronic control in random access analysers

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Improvements in microchip technology have produced a new breed of computerized laboratory analysers. Modern analysers have both self-acting and self-regulating mechanisms. Automatic self-checking diagnostics allow preventive service and repair. An instrument can be implemented through changes in software. Chemometrics help to check reagent integrity, validate calibration, and quality control. Computer-assisted interpretation is just beginning to be a possibility.

The computer revolution has resulted in a new breed of instruments for laboratory analyses. This paper discusses the impact of electronics on process control, diagnostics, instrument upgrades and chemometrics.

Process control

It would take hours for a human being to choose the best way to operate different panels of parameters; random access analysers do so immediately. Analysers like the Technicon Autoanalysers, were first mechanized, now they are automated with self-acting and self-regulating mechanisms.

In old instruments, a central processor was used to carry out all functions with real constraints placed on the software. Decentralized control provides much more control and security, and connection with other computers is easier – see figure 1.

Diagnostics

Automatic self-checking diagnostics on start up or during operation provide assurance on electrochemical, memory and computational functions. Diagnosis can be requested by the operator for preventive service or repair. Instrument repair, often by replacement of a circuit board is usually made easier with system diagnostics and downtime is minimized.

Upgrading instruments

All the functions are software controlled, i.e. by read only memory (ROM) chips, programmed by the manufacturer. As a consequence, changes in the operation and capabilities of an instrument can now be implemented through changes in software (via a disk), a memory board or a microchip on a board. Examples are data for new parameters, new algorithms for calibration curves, accelerating a process to increase throughput, and changing the operation of a robotic part of the system.

Chemometrics

Chemometrics is the application of mathematical and statistical methods to chemistry. Modern systems are able to acquire, store, process and manage large data sets in real time by using a variety of sophisticated algorithms. Chemometrics uses such techniques as advanced statistics, imaging, optimization and control, artificial intelligence, and computer-assisted interpretation.

It is appropriate to emphasize the control of the measurements:

For a single chemical reaction, curves can be fitted to pre-established algorithms, providing checks on reagent integrity. This gives better linearity and fewer re-runs.

Limits for slope and intercept of a linear calibration can be memorized – see figure 2.

Quality control programs can be included in the software with acceptable limits.

Figure 1. Evolution of microprocessor control in random access analysers.
Figure 2. Validation of the calibration step.

**Computer-assisted interpretation**

Computer-assisted interpretation in clinical chemistry presently includes interpretation of a patient result compared to the range for a given population (age, sex, illness); interpretation of a profile of parameters for one patient; and the suggestion of a complementary analysis.

**Conclusion**

Microchip technology will have an increasing impact on the laboratory with the advent of fully automated analytical systems. Therefore there must be a significant effect on the way laboratories are organized and operated.

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