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Analysis, Conversion and Visualisation of Particle Size Data combined with a Data Based Control System for Particulate Processes

1   Introduction

Modern methods of particle size analysis, compared to traditional methods, produce more and also more detailed information about the measured size distribution, the parameters of the analysing procedure including sample preparation, and the settings of the instrument which, in most cases, is a complex, automated system.

Table 1 lists the measuring frequency for some applications of laser diffraction in comparison to sieving, representing a sample traditional method of particle size analysis.

Method	measuring frequency
sieving	typ. 2 per hour
laser diffraction in suspension	typ. 10 per hour
laser diffraction with dry powder	typ. 25 per hour
ultrasonics extinction	typ. 30 per hour
laser diffraction with aerosol sprays	up to 2000 per second

Table 1:   Measuring frequency of different methods of particle size analysis

The increased amount of information requires proper software tools for the management of the data. Most of the modern particle size analysing systems are equipped with and controlled by an industry standard PC. So using PC compatible hard- and software for the processing of the data is evident. The multitasking capability of modern operating systems for PC's has grown considering the

development from Windows3.1 over Windows95 to Windows NT. This opened the chance to implement programme modules running in parallel and using UNIX-like inter-process communication.

2 Acquisition and Management of PSD data

A modular programme system for the measurement and the administration of particle size data was developed that effectively uses the power of a multitasking PC operating system (Windows 95 / NT).
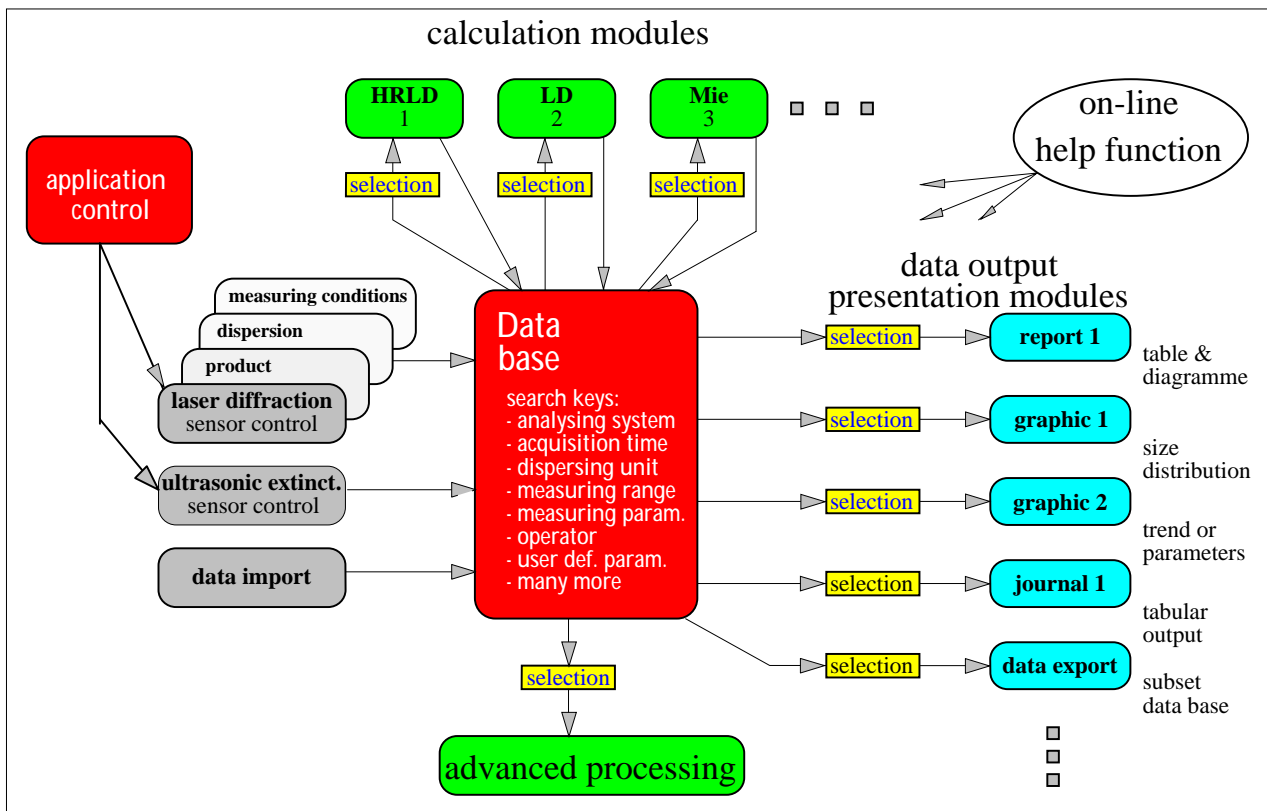
Figure 1: Interrelation of the programme modules.

Modules for measurements by laser diffraction or ultrasonic extinction are provided as well as modules for the evaluation and representation of the results. Due to the modular design the software can be used interactively or in stand-alone, fully automatic applications.

Object-oriented programming techniques were used to reflect the various types of measuring systems and unit operations. Currently supported are

–   laser diffraction of dry powders, suspension, and aerosol sprays, whereby a large number of dispersing systems may be used to ensure an optimal handling of the particles for the analysis, all operating parameters of the measuring set-up are stored in the data base.

–   ultrasonic extinction of suspensions and emulsions.

A networked data base holds all information. The analysers are connected to and controlled by one of the networked PC's (see Figure 2).
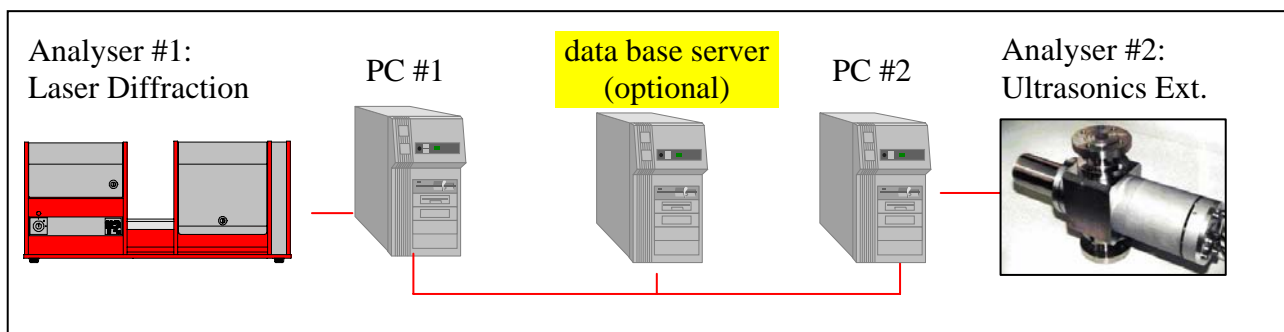

Figure 2:   Sample Schematic of a network with server and two PC-operated analysing systems

A messaging concept allows multiple instances of the programmes to be used on different PC's in a network, while all information is automatically kept up-to-date. Filter modules serve to adapt each process to a specific purpose. Selection criteria (filter) may be defined to extract data from the data base for evaluation, representation, or further processing.

The programme system provides powerful options of representing the results of measurement or processing as tables and diagrams of all common grids (for example RRSB, log. normal, and power grid). All reports are user-configurable. Printed output is compatible to standard word processing and spreadsheet software.

An integrated macro interpreter serves for the purpose of programming user-specific sequences of measurement, data processing, and control of peripheral devices, for example, a robot. In this way, a fully automated quality control system can be established.

Programme modules for the control of particulate processes can easily be added to the system because the data base used is an industry standard. Software tools to read the data are provided by the supplier of the data base.
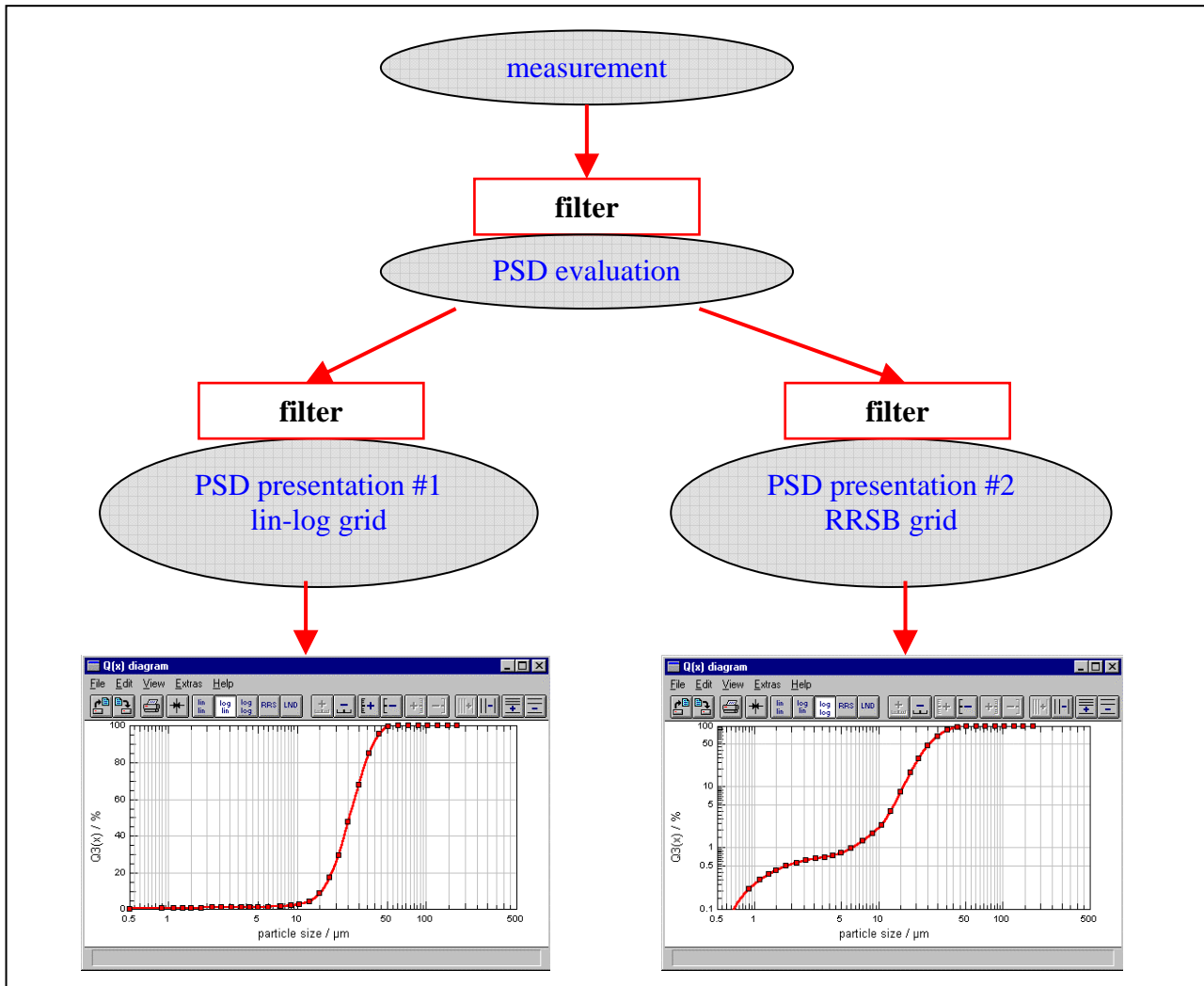
Figure 3:   Concept of message piping and filtering for multiple instances of programme modules

3   Advanced Processing of PSD data

Compatible to the system, a software programme was developed featuring the extended analysis of particle size data of arbitrary data sources. Data can be extracted from the data base into projects, thus supporting the concept of scientific analysis of a fixed set of data. Statistical analyses including statistical tests (t-test and F-test) can be applied to the data.

Mixtures and separation processes can be simulated and analysed using the size distribution data of the components. Mathematical models for comminution and the analysis of a milling process are also provided.

One application example out of the palette mentioned above is the analysis of a mixture.
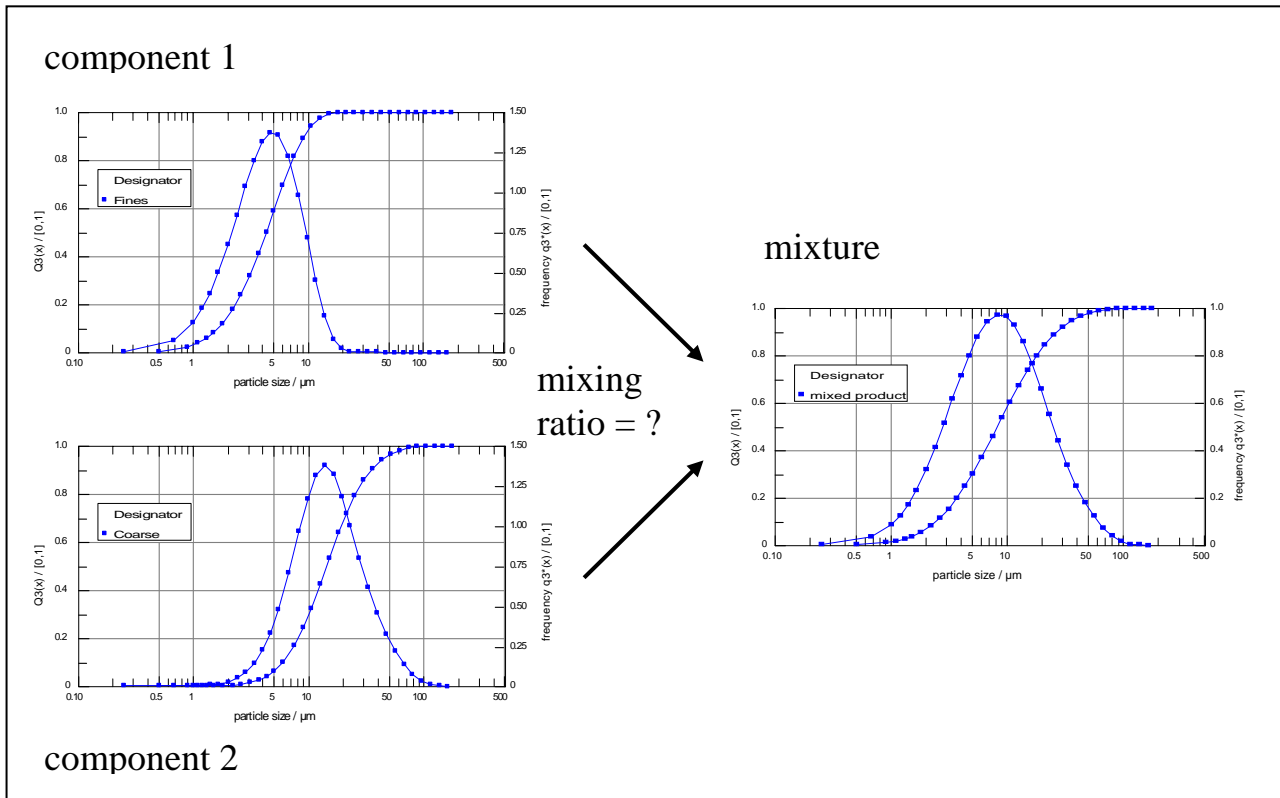
Figure 4: Application example: analysis of a mixture

Depending on the configuration of input data the resulting size distribution can be calculated as well as the PSD of one of the components or the mixing ratio.

4 Conclusions

The new software uses the multitasking features of modern industry standard PC operating systems in a way that used to be typical for multi-user systems of mainframe computers. In addition to that, networking is fully supported. The resulting modular design of the software makes it easy to adapt to

– different measuring methods of particle sizing analysis,

– user-specific requirements of data management and data output,

– distributed application of the programme modules using a client-server structure,

– on-line control of particulate processes by individual programme modules.

A programme module for the advanced processing of particle size related data is contained in the system to provide methods for the profound analysis of processes and unit operations. With the help of this programme and software add-ons which are also available, the growing demand for optimisation of particulate processes can be fulfilled.