A HARDWARE–SOFTWARE COMPLEX OF THE INFRARED FOURIER SPECTROMETER FOR AIR POLLUTION MONITORING

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On the basis of a experimental laboratory model, the principles of implementation of a hardware-software complex Fourier spectrometry, data collection and processing are compiled and justified. This complex can be used as for the ground based and moving platform observation as for flight experiments. A mathematical algorithm and a program code for fitting the observed and modelled spectra were developed for express-analysis of Fourier-transform spectra with the goal of control of any dangerous gas compound pollutions.

On the basis of a laboratory model the main principles of implementation of a hardware-software complex (see Fig. 1) of control, data acquisition and processing for the infrared Fourier spectrometer [1] designed for on-board experiments are justified and developed taking into account the demands of safety, speed and energy consumption.

The preference of an IBM compatible in comparison with a specialized digital signal processor as a nucleus of the system is justified. The development of interface components for an usual personal computer has a number of advantages. First of all, the standard hardware and software (compilers, library) are used. Secondly, a safety of the system is enhanced whilst the platforms for development, testing and using are coincident.

The interface of data processing and device control systems are made and the requirements to the software and resources of PC are elaborated.

The four main functions are given to the program part:

- registration of the signals arriving from the interface card of the Fourier spectrometer;
- mathematical data arrays processing;
- visual representation of the data;
- the processing of any user's input.

The results of test measurements of main characteristics for our model Fourier spectrometer have shown

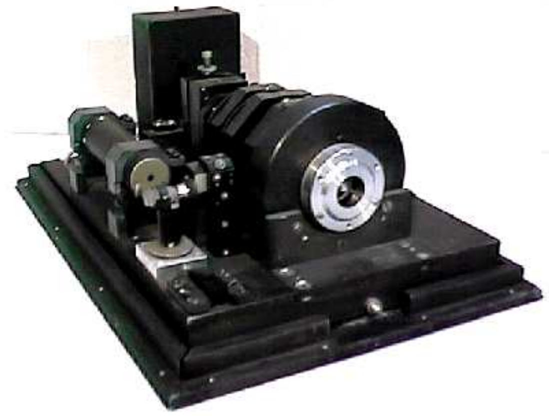

Figure 1: IR Fourier spectrometer general view

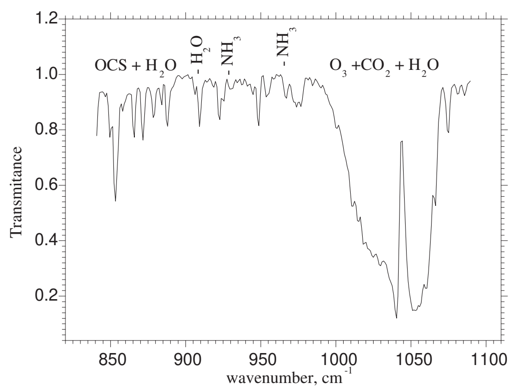

Figure 2: Solar spectra. 800–1100 cm^{-1} region, $hw = 2$ cm^{-1}

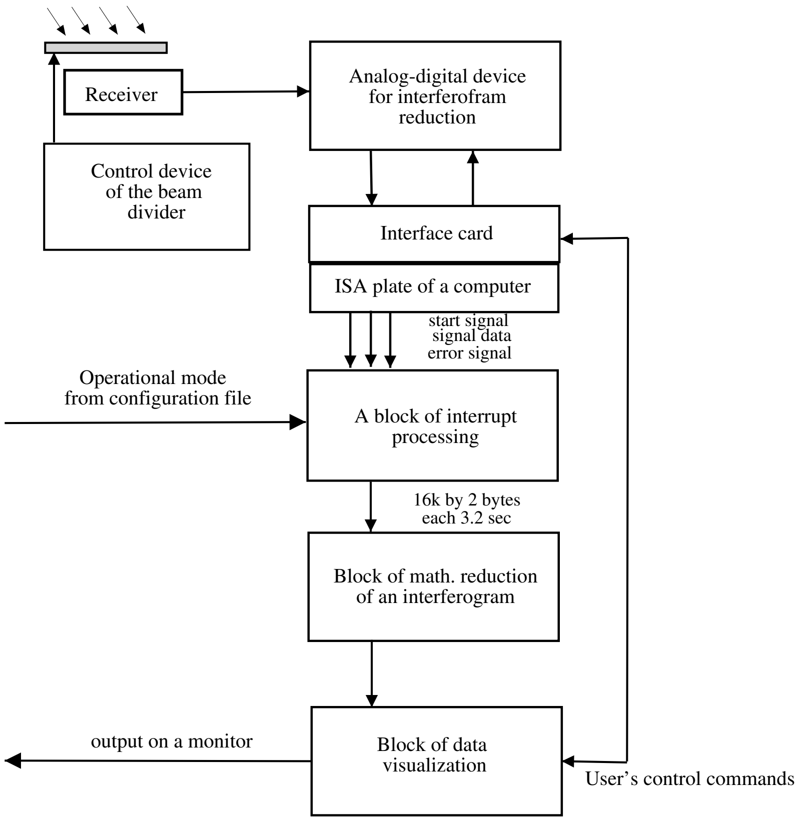

Figure 3: Block-scheme of the Fourier spectrometer's interface

an availability of its continuous work in a real time mode along 500–1000 scans without any failures. The capacity of available computer (Pentium 150 MHz) is quite enough for simultaneous registration, transformation, visualization and processing of a signal.

A block of interrupt processing provides continuous processing of hardware interrupt requests, coming from the spectrometer interface card. It combines the consistently arriving signals in a data array and processes faulty situations.

Block of mathematical processing
• interferogram appodization (by cosine, gaussian);
• fast Fourier transform code (16384 points in 0.04 sec);
• smoothing of a spectrum (on ≥ 3 points).
The storage of a spectrum is carry out separately on beam divider directions. The calculation of average values and their dispersions is possible for any data array length.
The calculations of 100% intensity line for two accumulated spectra.

A block of data visualization ensures
• the representation of two data arrays as diagrams (interferogram + spectrum, spectrum + spectrum, 100% intensity line + spectrum);
• the change of a scale (increase, reduction);
• graphic cursor.

REFERENCES

[1] *Bell R. J.* Introductory Fourier transform spectroscopy.–New York – London: Academic Press, 1972.–398 p.