lytical laboratories. The use of an IISS/T according to the invention facilitates application of spectrum-measurement-based methods in real-time environmental, agricultural, medical, and industrial monitoring. It also facilitates use of a hand-held spectrometer designed for specific applications or for a variety of applications.

The proposed invention permits implementation of sensors that are advantageous in many ways including the following. The proposed IISS/T is autonomous in the sense, that it is capable of producing output measurement results without external operations and/or computing. The IISS/T architecture supports manufacturing of various low-price intelligent spectrometric probes and hand-held spectrometric instruments without some of the technological problems inherent in high-resolution optical processing spectrometers. The proposed IISS/T is easily adapted to diverse applications by reprogramming the specialized digital signal processor. The proposed method for spectrum measurement is particularly advantageous for integrated miniature implementation of the IISS/T. The IISS/T is robust to mechanical, electromagnetic, chemical and biological influences, due to its compact packaging and integrated design. Further, it is less cumbersome for transport, installation, testing, and repair.

In a pre-defined specialized application, the metrological parameters—variety and ranges of measured quantities, as well as accuracy of measurement—of the IISS/T are comparable to those of a general-purpose laboratory spectrophotometers; yet, the IISS/T has a significantly lower manufacturing cost. Using current technology, an IISS/T is manufacturable as small as 12 cm^3. For this reason the IISS/T is naturally adapted for in situ measurements. A network of deployed IISS/T may replace the vehicle-based system of sampling, currently used in the environmental monitoring. Alternatively, a network of low-resolution sensors coupled with a single processor is useful for random sampling sequential sampling, or, when the processor is significantly more powerful than necessary for augmenting resolution and accuracy of a single spectrum, for simultaneous sampling. The main advantage of this solution would be an increase in the reliability and informativeness of environmental monitoring due to the continual sampling in situ. Such a network of IISS/T is useful in chemical, pharmaceutical and biotechnological industries for continual monitoring of manufacturing processes. The main advantage of this solution within those industries is an increase in the reliability and safety of manufacturing processes, as well as an improvement of the quality of production.

Without the digital processor performing, spectral augmentation, no useful measurement results are obtained. This is distinct from existing spectral transducers having optical processing, the results of which are provided to an external processor for spectral analysis such as noise filtering and so forth.

The price of an IISS/T manufactured according to an embodiment of the invention, using standard integration technologies, is comparable with the price of a semiconductor device than that of classic spectrometer. The availability of such an IISS/T will change the approach to the use of light-spectrum-measurement-based techniques, currently limited to the laboratory environment for practical purposes. This invention provides a method of implementing a spectrometer for use in situ in many metrological applications.

Clearly use of the exemplary method described herein is not limited to the IISS/T. The method of spectral correction and resolution augmentation described above is useful in many applications other than a hand-help spectrometer. For example, in high precision measurement of spectra or in the design of lower cost high precision spectrometers. Similarly, the exemplary method of spectral enhancement performed in the processor of the IISS/T as described above, is an exemplary method of enhancing spectral accuracy and resolution. It is exemplary in nature and not intended to limit the scope of the inventive apparatus.

The exemplary embodiment of the invention presented above is not intended to limit the applicability of the method to the presented example. Neither is it intended to limit the variety of algorithms that may be used to embody the operations of the specialized digital signal processor. Numerous other embodiments may be envisaged without departing from the spirit or scope of the invention.

What is claimed is:

1. A method of spectral measurement comprises the steps of:

capturing data representative of a first spectrum of a sample using a spectral transducer;

comparing the data representative of the first spectrum to data representative of a known spectrum for a sample substantially identical to the first sample and determining calibration data for transforming, according to a determined transformation, the data representative of the first spectrum into an approximation of the data representative of the known spectrum;

capturing data representative of a spectrum of a second sample using the spectral transducer; and,

estimating an ideal spectrum for the second sample using the calibration data, the estimation performed using the determined transformation.

2. The method of spectral measurement as defined claim **1** wherein the spectral transducer has a resolution R>5 nm.

3. The method of spectral measurement as defined claim **1** wherein the spectral transducer has a resolution R, 1 nm$\leqq$R$\leqq$15 nm.

4. A method of spectral measurement as defined in claim **1** wherein

the data representative of the first spectrum is defined by $\{\tilde{y}_n^{cal}\}$,

the known spectrum is defined by $x^{cal}(\lambda)$, and

wherein the calibration data is determined by the steps of:

choosing a form of an ideal peak $v_s(\lambda,l)$ and of projection operator $\mathcal{G}$ and reconstruction operator $\mathcal{R}$

pre-processing the data representative of the first spectrum $\{\tilde{y}_n^{cal}\}$;

determining parameters $p_{\mathcal{G}}$ of projection operator $\mathcal{G}$ and parameters $p_{\mathcal{R}}$ of reconstruction operator $\mathcal{R}$; and,

storing calibration data comprising the determined parameters in memory.

5. A method of spectral measurement as defined in claim **1** wherein the step of estimating the ideal spectrum comprises the steps of:

estimating positions l of peaks within a spectrum of the second sample on the basis of an estimate $\hat{s}(\lambda)$ of $s(\lambda;l,a)$;

estimating magnitudes a of the peaks; and,

iteratively correcting the estimates of the parameters of the peaks.

6. A method of spectral measurement as defined in claim **5** wherein the steps of estimation of the magnitudes a and iterative correction of estimates of magnitudes a and positrons l of the peaks is performed using one of the following: