CLAIMS

The invention claimed is:

1. A method of determining a characteristic of a sample, comprising:

directing a handheld characteristic analyzer at the sample, the handheld characteristic analyzer having at least one integrated computational element arranged therein;

activating the handheld characteristic analyzer, thereby optically interacting the at least one integrated computational element with the sample and generating optically interacted light;

receiving the optically interacted light with at least one detector arranged within the handheld characteristic analyzer;

generating an output signal corresponding to the characteristic of the sample with the at least one detector;

receiving the output signal with a signal processor communicably coupled to the at least one detector; and

determining the characteristic of the sample with the signal processor.

2. The method of claim 1, wherein activating the handheld characteristic analyzer further comprises:

actuating a trigger mechanism provided on the handheld characteristic analyzer; and

providing electromagnetic radiation to the sample from an electromagnetic radiation source arranged within the handheld characteristic analyzer.

3. The method of any of the preceding claims, wherein directing the handheld characteristic analyzer at the sample further comprises extending one or more fiber optic probes to the sample, the one or more fiber optic probes being communicably coupled to the characteristic analyzer.

4. The method of claim 3, further comprising:

actuating a trigger mechanism provided on the handheld characteristic analyzer;

conveying electromagnetic radiation to the sample via the one or more fiber optic probes, the electromagnetic radiation being emitted from an electromagnetic radiation source arranged within the handheld characteristic analyzer; and

conveying optically interacted radiation from the sample to the optical computing device via the one or more fiber optic probes.

5. The method of any of the preceding claims, wherein the at least one detector is a first detector, the method further comprising:

emitting electromagnetic radiation from an electromagnetic radiation source arranged within the handheld characteristic analyzer;

receiving and detecting with a second detector at least a portion of the electromagnetic radiation;

generating with the second detector a compensating signal indicative of radiating deviations of the electromagnetic radiation source; and

computationally combining the output signal and the compensating signal with the signal processor communicably coupled to the first and second detectors, whereby the output signal is normalized.

6. The method of any of the preceding claims, further comprising optically interacting the at least one integrated computational element with a substance present within the sample.

7. The method of claim 6, wherein the characteristic of the sample is a concentration of the substance present within the sample.

8. The method of claim 6, wherein the wherein the sample is a fluid comprising a fluid selected from the group consisting of drinking water, separated production water, gasoline fuel, diesel fuel, a gas, machinery lubricant, grease, hydraulic fluid, coolant fluid, and any combinations thereof.

9. The method of any of the preceding claims, wherein directing a handheld characteristic analyzer at the sample further comprises directing the handheld characteristic analyzer at least one of a containment vessel, a pipeline, a weld in a pipeline or vessel, and a connection or fitting in a pipeline or vessel.

10. The method of claim 9, further comprising detecting fluid emissions or leakage of the sample with the handheld characteristic analyzer.

11. The method of any of the preceding claims, further comprising generating a resulting output signal indicative of the characteristic of the sample with the signal processor.

12. The method of claim 11, further comprising:

conveying the resulting output signal to a communication port defined on the handheld characteristic analyzer, the communication port being communicably coupled to the signal processor; and

communicating the resulting output signal from the communication port to an external processing device communicably coupled thereto.

13. The method of claim 11, further comprising

conveying the resulting output signal to a wireless link arranged within the handheld characteristic analyzer and communicably coupled to the signal processor; and

communicating the resulting output signal from the wireless link to a remote wireless device.

14. The method of claim 11, further comprising

conveying the resulting output signal to a graphical user interface arranged on the handheld characteristic analyzer and communicably coupled to the signal processor; and

generating one or more visual representations of the characteristic of the sample with the graphical user interface.

15. The method of claim 14, wherein providing one or more visual representations of the characteristic of the sample further comprises providing an optical spectra of the characteristic of interest.

16. The method of claim 14, wherein providing one or more visual representations of the characteristic of the sample further comprises simultaneously displaying concentration levels of one or more substances or chemical compounds.

17. The method of claim 14, wherein activating the handheld characteristic analyzer further comprises:

actuating a trigger mechanism provided on the handheld characteristic analyzer; and

capturing a visual light image with the handheld characteristic analyzer.

18. The method of claim 17, wherein providing one or more visual representations of the characteristic of the sample further comprises:

displaying the visual light image on the graphical user interface; and

overlaying the visual light image with the one or more visual representations of the characteristic of the sample.

19. The method of claim 14, wherein providing one or more visual representations of the characteristic of the sample further comprises displaying trend data relating to a concentration of one or more substances present within the sample.

20. The method of any of the preceding claims, wherein the sample is black dust accumulation on an inline inspection device, the method further comprising:

optically interacting the at least one integrated computational element with the black dust; and

determining a characteristic of the black dust.

21. The method of any of the preceding claims, wherein directing the handheld characteristic analyzer at the sample further comprises:

aiming the handheld characteristic at a pipeline; and

monitoring emissions or leakage of the sample from the pipeline.

What is claimed is:

1. A method of determining a characteristic of a sample, comprising:

directing a handheld characteristic analyzer at the sample, the handheld characteristic analyzer having at least one integrated computational element arranged therein;

activating the handheld characteristic analyzer, thereby optically interacting the at least one integrated computational element with the sample and generating optically interacted light;

receiving the optically interacted light with at least one detector arranged within the handheld characteristic analyzer;

generating an output signal corresponding to the characteristic of the sample with the at least one detector;

receiving the output signal with a signal processor communicably coupled to the at least one detector; and

determining the characteristic of the sample with the signal processor wherein an amplitude of the optically interacted light is proportional to a vector product of a regression vector associated with the characteristic of the sample and an input light beam, and wherein the regression vector is represented by a plurality of alternating layers of two materials having different indices of refraction in the integrated computational element, each of the layers having a selected thickness.

2. The method of claim 1, wherein activating the handheld characteristic analyzer further comprises:

actuating a trigger mechanism provided on the handheld characteristic analyzer; and

providing electromagnetic radiation to the sample from an electromagnetic radiation source arranged within the handheld characteristic analyzer.

3. The method of claim 1, wherein directing the handheld characteristic analyzer at the sample further comprises extending one or more fiber optic probes to the sample, the one or more fiber optic probes being communicably coupled to the characteristic analyzer.

4. The method of claim 3, further comprising:

actuating a trigger mechanism provided on the handheld characteristic analyzer;

conveying electromagnetic radiation to the sample via the one or more fiber optic probes, the electromagnetic radiation being emitted from an electromagnetic radiation source arranged within the handheld characteristic analyzer; and

conveying optically interacted radiation from the sample to the signal processor via the one or more fiber optic probes.

5. The method of claim 1, wherein the at least one detector is a first detector, the method further comprising:

emitting electromagnetic radiation from an electromagnetic radiation source arranged within the handheld characteristic analyzer;

receiving and detecting with a second detector at least a portion of the electromagnetic radiation;

generating with the second detector a compensating signal indicative of radiating deviations of the electromagnetic radiation source; and

computationally combining the output signal and the compensating signal with the signal processor communicably coupled to the first and second detectors, whereby the output signal is normalized.

6. The method of claim 1, further comprising optically interacting the at least one integrated computational element with a substance present within the sample.

7. The method of claim 6, wherein the characteristic of the sample is a concentration of the substance present within the sample.

8. The method of claim 6, wherein the sample is a fluid comprising a fluid selected from the group consisting of drinking water, separated production water, gasoline fuel, diesel fuel, a gas, machinery lubricant, grease, hydraulic fluid, coolant fluid, and any combinations thereof.

9. The method of claim 1, wherein directing a handheld characteristic analyzer at the sample further comprises directing the handheld characteristic analyzer to at least one of a containment vessel, a pipeline, a weld in a pipeline or vessel, and a connection or fitting in a pipeline or vessel.

10. The method of claim 9, further comprising detecting fluid emissions or leakage of the sample with the handheld characteristic analyzer.

11. The method of claim 1, further comprising generating a resulting output signal indicative of the characteristic of the sample with the signal processor.

12. The method of claim 11, further comprising:

conveying the resulting output signal to a communication port defined on the handheld characteristic analyzer, the communication port being communicably coupled to the signal processor; and

communicating the resulting output signal from the communication port to an external processing device communicably coupled thereto.

13. The method of claim 11, further comprising:

conveying the resulting output signal to a wireless link arranged within the handheld characteristic analyzer and communicably coupled to the signal processor; and

communicating the resulting output signal from the wireless link to a remote wireless device.

14. The method of claim 11, further comprising:

conveying the resulting output signal to a graphical user interface arranged on the handheld characteristic analyzer and communicably coupled to the signal processor; and

generating one or more visual representations of the characteristic of the sample with the graphical user interface.

15. The method of claim 14, wherein providing one or more visual representations of the characteristic of the sample further comprises providing an optical spectrum of the characteristic of interest.

16. The method of claim 14, wherein providing one or more visual representations of the characteristic of the sample further comprises simultaneously displaying concentration levels of one or more substances or chemical compounds.

17. The method of claim 14, wherein activating the handheld characteristic analyzer further comprises:

actuating a trigger mechanism provided on the handheld characteristic analyzer; and

capturing a visual light image with the handheld characteristic analyzer.

18. The method of claim 17, wherein providing one or more visual representations of the characteristic of the sample further comprises:

displaying the visual light image on the graphical user interface; and overlaying the visual light image with the one or more visual representations of the characteristic of the sample.

19. The method of claim 14, wherein generating one or more visual representations of the characteristic of the sample further comprises displaying trend data relating to a concentration of one or more substances present within the sample.

20. The method of claim 1, wherein the sample is black dust that has accumulated on an inline inspection device, the method further comprising:

optically interacting the at least one integrated computational element with the black dust; and

determining a characteristic of the black dust.

21. The method of claim 1, wherein directing the handheld characteristic analyzer at the sample further comprises:

aiming the handheld characteristic at a pipeline; and

monitoring emissions or leakage of the sample from the pipeline.