CLAIMS

What is claimed is:

1. A spectrofilometer (400) comprising:

at least one profilometer including a profilometer image pattern projection system (430) for projecting an incident image pattern on an object of interest (304);

an enclosure (415); and

an interferometer comprising one or more interferometer beam-splitting elements (420) and/or a spectrometer comprising one or more spectrometer beam-dispersing elements; and

an array (112) of radiation-sensitive elements (110) for detecting the incident image pattern after it has been reflected from multiple points (306) of the object of interest;

wherein the one or more interferometer beam-splitting elements and/or the one or more spectrometer beam-dispersing elements are housed in the enclosure (415) and are configured to direct respective optical outputs to the array (112);

wherein the interferometer and/or the spectrometer share one or more of the radiation-sensitive elements with the at least one profilometer to capture, respectively, an interferometric fringe pattern and/or a diffraction pattern;

wherein the interferometer beam-splitting elements (420) and/or the spectrometer beam-dispersing elements (425) are configured, upon receiving incident electromagnetic radiation (E), to produce secondary output beams that, respectively, interfere and/or diffract so as to form characteristic patterns illuminating and being detected by the array (112);

and

wherein the spectrofilometer further comprises one or more processors (405), and a memory, configured to store instructions which, when executed by the one or more processors, cause the one or more processors to:

- read the signals from the array (112) to form detector data representative of a spatial intensity profile, thus capturing an image of the reflected pattern;

- separate modality-specific components in the detector data based on differences in their spatial intensity distribution characteristics; and

- recover profile information from a spatial intensity profile using the separated modality-specific components.

2. The spectrofilometer of claim 1, further comprising one or more reflective surfaces between the optical outputs.

3. The spectrofilometer of claim 2, wherein the one or more reflective surfaces comprise one or more optical coatings on one or more of the one or more reflective surfaces.

4. The spectrofilometer of claim 2, wherein the one or more reflective surfaces are microelectromechanical systems (MEMS) elements.

5. The spectrofilometer of claim 4, wherein each MEMS element is controllable and configured to reflect a portion of the incident electromagnetic radiation.

6. The spectrofilometer of claim 1, wherein the one or more radiation-sensitive elements are configured to detect one or more inputs originating from one or more spatially distinct locations.

7. The spectrofilometer of claim 6, wherein the one or more inputs comprise the one or more optical outputs.

8. The spectrofilometer of claim 6, wherein the one or more inputs comprise one or more imaging bundles.

9. The spectrofilometer of claim 6, wherein the one or more inputs comprise one or more optical waveguides.

10. The spectrofilometer of claim 9, wherein the one or more optical waveguides comprise one or more optical fibers.

11. The spectrofilometer of claim 1, further comprising one or more optical waveguides.

12. The spectrofilometer of claim 11, wherein the one or more optical waveguides comprise one or more optical fibers.

13. The spectrofilometer of claim 12, wherein the one or more optical fibers comprise one or more of: microstructured optical fibers; and multicore optical fibers.

14. The spectrofilometer of claim 1, wherein the one or more interferometer beam-splitting elements and/or the one or more spectrometer beam-dispersing elements are dynamically adjustable.

15. The spectrofilometer of claim 1, wherein the instructions, when executed by the one or more processors, further cause the one or more processors to:

recover data from the spatial intensity profile using one or more of:

transform processing techniques;
curve fitting techniques;
frequency filtering techniques;
fringe counting techniques;
interpolation techniques;
weighting techniques;
one or more orders of differentiation;
one or more orders of integration;
predictive analysis techniques;
machine learning techniques; and
artificial intelligence techniques,

wherein the data comprises one or more of:

temporal data;
spectral data;
phase data;
amplitude data; and

polarization data.

16. A method of analyzing electromagnetic radiation, comprising:

providing a spectrofilometer, comprising:

an enclosure (415);

one or more processor (405);

a memory;

at least one profilometer including a profilometer image pattern projection system (430) for projecting an incident image pattern on an object of interest (304);

an interferometer comprising one or more interferometer beam-splitting elements (420) and/or a spectrometer comprising one or more spectrometer beam-dispersing elements; and

an array (112) of radiation-sensitive elements (110) arranged to generate signals in response to incident electromagnetic radiation; wherein the one or more interferometer beam-splitting elements and/or the one or more spectrometer beam-dispersing elements are housed in the enclosure (415) and are configured to direct respective optical outputs to the array (112);

wherein the interferometer and/or the spectrometer share one or more of the radiation-sensitive elements with the at least one profilometer to capture, respectively, an interferometric fringe pattern and/or a diffraction pattern;

wherein the interferometer beam-splitting elements (420) and/or the spectrometer beam-dispersing elements (425) are configured, upon receiving incident electromagnetic radiation (E), to produce secondary output beams that, respectively, interfere and/or diffract so as to form characteristic patterns illuminating the array (112); and

reading, using the one or more processors, the signals from the array (112) to form detector data representative of a spatial intensity profile, thus capturing an image of the reflected pattern;

separating, using the one or more processors, modality-specific components in the detector data based on differences in their spatial intensity distribution characteristics; and

recovering, using the one or more processors, profile information from a spatial intensity profile using the separated modality-specific components

17. The method of claim 16, further comprising:

recovering, using the processor, data from the spatial intensity profile using one or more of:

transform processing techniques;

curve fitting techniques;

frequency filtering techniques;

fringe counting techniques;

interpolation techniques;

weighting techniques;

one or more orders of differentiation;

one or more orders of integration;

predictive analysis techniques;

machine learning techniques; and artificial intelligence techniques,

wherein the data comprises one or more of:

temporal data;

spectral data;

phase data;

amplitude data; and polarization data.