Claims

What is claimed is:

1. A hyperspectral imaging apparatus, comprising:

a micro-lens array comprising a plurality of micro-lenses;

a filter array comprising a plurality of tunable filters, each of the plurality of tunable filters being optically coupled to a respective micro-lens of the plurality of micro-lenses; and

a controller configured to tune at least one of the tunable filters;

wherein each micro-lens and the corresponding coupled tunable filter are configured to generate a spectrally filtered image of a scene, such that the micro-lens array and the filter array generate a plurality of spectrally filtered images of the scene for receiving by a plurality of areas of an image sensor;

wherein each of the plurality of tunable filters is tunable to transmit a selected wavelength within a respective spectral band, wherein the spectral bands of the plurality of tunable filters are different from each other; and

wherein the controller is configured to tune at least one of the tunable filters at different image capture times of the image sensor, such that each tunable filter being tuned by the controller is configured to generate separate spectrally filtered images at different wavelengths corresponding to different image capture times.

2. The hyperspectral imaging apparatus of claim 1,

wherein each tunable filter comprises one of a Fabry-Perot filter, a Lyot filter, or an electrochromic window.

3. The hyperspectral imaging apparatus of claim 1,

wherein the tunable filters comprise a material having at least one of a size or a refractive index that is variable in response to an electrical signal.

4. The hyperspectral imaging apparatus of claim 1,

wherein each tunable filter is attached to a surface of a respective micro-lens,

wherein the plurality of micro-lenses and the plurality of tunable filters are arranged corresponding to the plurality of areas of the image sensor.

5. The hyperspectral imaging apparatus of claim 1,

wherein the controller is configured to synchronize the tuning of the filter array with the image capture at the image sensor.

6. The hyperspectral imaging apparatus of claim 1,

wherein one or more of the tunable filters is configured to transmit a plurality of wavelengths simultaneously.

7. The hyperspectral imaging apparatus of claim 1, wherein the hyperspectral imaging apparatus is configured to operate in one or both of a first mode of a first spectral resolution and a second mode of a second spectral resolution, the second spectral resolution being higher than the first spectral resolution;

wherein in the first spectral resolution mode, the plurality of tunable filters are configured to generate the plurality of spectrally filtered images at an image capture time;

wherein in the second spectral resolution mode, the plurality of tunable filters are configured to generate different sets of spectrally filtered images at different image capture times by tuning the respective tunable filters to transmit different wavelengths at different image capture times.

8. The hyperspectral imaging apparatus of claim 1, further comprising:

a converging lens for converging the plurality of spectrally filtered images towards the image sensor.

9. The hyperspectral imaging apparatus of claim 1, being adapted for attachment to and detachment from the image sensor, the image sensor being comprised in a portable device.

10. The hyperspectral imaging apparatus of claim 1, further comprising

a power supply configured to supply an electrical signal for tuning the filter array.

11. The hyperspectral imaging apparatus of claim 1,

wherein each tunable filter comprises:

a first metal layer;

a second metal layer; and

a piezoelectric layer between the first metal layer and the second layer, the piezoelectric layer comprising a piezoelectric material;

wherein the piezoelectric material is configured to modulate a distance between the first metal layer and the second metal layer based on an electric field applied across the piezoelectric material.

12. The hyperspectral imaging apparatus of claim 1, wherein each tunable filter comprises a dielectric layer comprising an elastomer.