CLAIMS

1. A speckle suppression subsystem for reducing speckles in an imagery system, the speckle suppression subsystem comprising:

an illumination setup comprising:

at least one light source configured to emit light at a narrow wavelength bandwidth; and

a plurality of wavelength converters configured to receive at least a portion of light emitted by at least one of the at least one light source and convert spectral properties of the received portion of light, wherein the wavelength converters are configured to form an array of spectrally differentiated input beams; and

a spectral beam combining (SBC) setup configured to:

combine the array of spectrally differentiated input beams emanating from the illumination setup, and

output a combined multispectral beam comprising multiple spectrally differentiated output beams propagated in parallel trajectories;

wherein the speckle suppression subsystem is configured to illuminate at least one surface of an area of interest (AOI) with the combined multispectral beam to suppress speckle and mitigate spatial intensity distribution expansion affects.

2. The speckle suppression subsystem of claim 1, wherein the SBC setup comprises at least two diffractive surfaces configured to combine the array of spectrally differentiated input beams.

3. The suppression subsystem of claim 1, wherein the SBC setup comprises:

a plurality of *n* dichroic mirrors, wherein each dichroic mirror *k*, with *k* ranging from 1 to *n*, is located and configured to:

receive an input beam *k* having a wavelength λ_k being one of the *n* spectrally differentiated input beams having different wavelengths λ_1 to λ_n,

reflect the received input beam,

transmit at least the previous input beams 1 to *k-1* with wavelengths λ_1 to λ_{k-1}; and

wherein the n^{th} dichroic mirror is configured to output the combined multispectral beam including wavelengths λ_1 to λ_n.

4. The speckle suppression subsystem of any one of claims 1 to 3, wherein the wavelength converters comprise an Optical Parametric Oscillators (OPOs) and/or Raman parametric wavelength converters.

5. The speckle suppression subsystem of claim 4, wherein at least one of the wavelength converters comprises an OPO configured to adjustably control the wavelength of the light being outputted thereby, based on temperature control.

6. The speckle suppression subsystem of any one of claims 1 to 5, further comprising an angular diversity setup, configured and positioned to receive the combined multispectral beam formed by the SBC setup, and to form a plurality of virtual multispectral output sources formed over a virtual output surface, causing light from the plurality of virtual multispectral output sources to impinge on the at least one surface of the AOI from different angles and at different wavelengths.

7. The speckle suppression subsystem of claim 6, wherein the angular diversity setup comprises a guiding optical setup configured to directly or indirectly receive the combined multispectral beam from the SBC setup, and to form the plurality of virtual multispectral output sources, each virtual light source being steered to have a different angular propagation direction, outputting light of spectral and angular diversity.

8. The speckle suppression subsystem of claim 7, wherein the angular diversity setup further comprises:

a projection optical setup configured and positioned to reduce spatial expansion of the light emanating from the guiding optical setup; and/or

an injection optical setup configured and positioned to receive the combined multispectral beam from the SBC setup, and to direct the received combined multispectral beam such as to pass through the guiding optical setup.

9. The speckle suppression subsystem of claim 7, wherein the guiding optical setup comprises a bar-type homogenizer guide element; or two lenslet arrays positioned in parallel and at a distance d from one another, having mutual focal length.

10. The speckle suppression subsystem of claim 9, wherein the guiding optical setup comprises the bar-type homogenizer guide element that has a rectangular or a trapezoid shape.

11. The speckle suppression subsystem of claim 9, wherein the guiding optical setup comprises the two lenslet arrays, and wherein the distance *d* corresponds to the mutual focal length.

12. The speckle suppression subsystem of claim 8, wherein the projection optical setup and/or the injection optical setup comprises one or more focusing and/or collimation lenses.

13. The speckle suppression subsystem of any one of claims 1 to 12, further comprising an optical path length (OPL) adjustment setup, configured and positioned to reduce mutual coherency between the beams by causing changes between OPLs of the spectrally differentiated output beams.

14. The speckle suppression subsystem of any one of claims 1 to 13, wherein the at least one light source of the illumination setup comprises at least one of: a laser device, a light emitting diode, and a laser element.

15. The speckle suppression subsystem of claim 14, wherein the at least one light source is an intra cavity or an extra cavity second harmonics generation type laser device, outputting pulsed laser light within a narrow wavelength band.

16. The speckle suppression subsystem of claim 15, wherein the laser device is configured for outputting light within the visible wavelength band.

17. The speckle suppression subsystem of claim 16, wherein the laser device is configured to output pulsed light of a pulse duration that is higher than 50 nano seconds (ns).

18. A method of reducing speckles in an imaging system, the method comprising:

generating an array of spectrally differentiated input beams by converting spectral properties of received light that has a narrow wavelength bandwidth, and

combining the beams of the generated array of spectrally differentiated input beams to yield a combined multispectral beam that comprises multiple spectrally differentiated output beams which propagate in parallel trajectories,

wherein the combined multispectral beam suppresses speckles and mitigates spatial intensity distribution expansion affects upon illuminating at least one surface of an area of interest (AOI) with the combined multispectral beam.

19. The method of claim 18, wherein combining the spectrally differentiated input beams is carried out by at least two diffractive surfaces configured to combine the array of spectrally differentiated input beams.

20. The method of claim 18, wherein combining the spectrally differentiated input beams is carried out by a plurality of *n* dichroic mirrors, wherein each dichroic mirror *k*, with *k* ranging from 1 to *n*, is located and configured to: receive an input beam *k* having a wavelength λ_k being one of the *n* spectrally differentiated input beams having different wavelengths λ_1 to λ_n, reflect the received input beam, and transmit at least the previous input beams 1 to *k-1* with wavelengths λ_1 to λ_{k-1}; and wherein the n^{th} dichroic mirror is configured to output the combined multispectral beam including wavelengths λ_1 to λ_n.

21. The method of any one of claims 18 to 20, wherein combining the spectrally differentiated input beams is carried out by optical parametric oscillators (OPOs) and/or Raman parametric wavelength converters, configured to adjustably control the wavelength of the light being outputted thereby, based on temperature control.

22. The method of any one of claims 18 to 21, further comprising forming a plurality of virtual multispectral output sources over a virtual output surface, causing light from the plurality of virtual multispectral output sources to impinge the at least one surface of the AOI from different angles and at different wavelengths.

23. The method of claim 22, wherein the angular diversity setup comprises a guiding optical setup configured to directly or indirectly receive the combined multispectral beam from the SBC setup and form the multiplicity of virtual multispectral output sources, each virtual light source being steered to have a different angular propagation direction, outputting light of spectral and angular diversity.

24. The method of claim 23, wherein the angular diversity setup further comprises:

a projection optical setup configured and positioned to reduce spatial expansion of the light emanating from the guiding optical setup; and/or

an injection optical setup configured and positioned to receive the combined multispectral beam from the SBC setup and direct the received combined multispectral beam such as to be passed through the guiding optical setup.

25. The method of claim 24, wherein the guiding optical setup comprises a bar-type homogenizer guide element; or two lenslet arrays positioned in parallel and at a distance D from one another having mutual focal lengths.

26. The method of claims 24 or 25, wherein the projection optical setup and/or the injection optical setup comprises one or more focusing and/or collimation lenses.

27. The method of any one of claims 18 to 26 further comprising causing changes between optical path lengths (OPLs) of each beam portion of the spectrally combined multispectral beam to reduce mutual coherency of the beam portions.

28. The method of any one of claims 18 to 27, wherein the at least one light source comprises at least one of: a laser device, a light emitting diode, a laser element.

29. The method of claim 28, wherein the at least one light source is an intra cavity or extra cavity second harmonics generation type laser device, outputting pulsed laser light within a narrow wavelength band.

30. The method of claim 29, wherein the laser device is configured for outputting light within the visible wavelength band.

31. The method of claims 29 or 30, wherein the laser device is configured to output pulsed light of a pulse duration that is higher than 50 nano seconds (ns).