

CLAIMS:

1. A method for use in ~~detecting and locating~~ a muzzle flash event, the method comprising ~~sensing, imaging electromagnetic radiation by an imager~~ comprising a Photo Detector Array (PDA), sensitive in at least a portion of the NIR and SWIR spectrum, electromagnetic radiation, passed through a filter of wherein the electromagnetic radiation propagating towards the PDA undergoes filtering to selectively passing in said portion a towards the PDA the electromagnetic radiation of one or more spectral ranges of relatively low atmospheric transmission, said sensing having an integration time shorter than in atmosphere of said at least a portion of the SWIR spectrum and wherein the PDA is not cryogenically cooled, whereby the imaging of such filtered electromagnetic radiation by said imager provides for both detection and location of a duration of the muzzle flash event.

2. ~~The~~ method of claim 1, wherein ~~for use in detection of a muzzle flash event, the method comprising sensing, by a Photo Detector Array (PDA),~~ sensitive in at least a portion of the NIR and SWIR spectrum, electromagnetic radiation, passed through a filter of electromagnetic radiation selectively passing in said portion a spectral range of low atmospheric transmission, said sensing having an integration time of the PDA is shorter than 10^{-2} s.

2.3. The method of claim 1 or 2, wherein said imager comprises at least 10,000 pixels.

3. ~~A method for use in detection of a muzzle flash event, the method comprising sensing by a Photo Detector Array (PDA) electromagnetic radiation, passed through a filter of electromagnetic radiation selectively passing a~~

~~spectral range of low atmospheric transmission and focused on said PDA, a per pixel field of view (FOV) of said PDA being larger at the focusing distance than said muzzle flash.~~

~~4. The method of Claim 3, wherein said focusing distance is larger than 50 m.~~

~~5. A method for use in detection of a muzzle flash event, the method comprising sensing by a Photo Detector Array electromagnetic radiation, passed through a filter of electromagnetic radiation selectively passing a spectral range of low atmospheric transmission and focused on said PDA, a per pixel field of view (FOV) of said PDA being larger than 0.1 degrees.~~

~~6. The method of Claim 3, 4 or 5, wherein said Photo Detector Array is sensitive in at least a portion of the NIR and SWIR spectrum.~~

~~7.4. A method of any one of the preceding claims, wherein for use in detection of a muzzle flash event, the method comprising sensing electromagnetic radiation by a Photo Detector Array (PDA) sensitive in at least a portion of the NIR and SWIR spectrum, the imagingsensing recurring with a dead time shorter than a duration of the muzzle flash event.~~

~~8. The method of Claim 7, wherein said dead time is shorter than the one tenth of said duration.~~

~~9. A method for use in detection of a muzzle flash event, the method comprising sensing electromagnetic radiation by a Photo Detector Array (PDA) sensitive in at least a portion of the NIR and SWIR spectrum, the sensing recurring with a dead time shorter than one millisecond.~~

~~10. A method for use in detection of a muzzle flash event, the method comprising sensing electromagnetic radiation by a Photo Detector Array (PDA) sensitive in at least a portion of the NIR and SWIR spectrum and multiplexing pixel signals of said PDA into at least two replicas.~~

5 ~~11. A method for use in detection of a muzzle flash event, the method comprising sensing, by a Photo Detector Array (PDA), electromagnetic radiation, passed through a filter of electromagnetic radiation selectively passing a spectral range of low atmospheric transmission, and multiplexing pixel signals of said PDA into at least two replicas.~~

10 ~~12. The method of Claim 10 or 11, comprising recording a replica of the pixel signals into a memory.~~

~~13. A method for use in detection of a muzzle flash event, the method comprising sensing, by a Photo Detector Array (PDA) sensitive in at least a portion of the NIR and SWIR spectrum, electromagnetic radiation, passed~~
15 ~~through a filter of electromagnetic radiation selectively passing in said portion a spectral range of low atmospheric transmission, said PDA having a fill factor larger than 60%.~~

~~14. The method of Claim 13, the fill factor being between 60% and 75%.~~

~~15. The method of Claim 13, the fill factor being between 75% and 90%.~~

20 ~~16. The method of Claim 13, the fill factor being higher than 90%.~~

~~17. A method for use in detection of a muzzle flash event, the method comprising sensing electromagnetic radiation by a Photo Detector Array (PDA) sensitive in at least a portion of the NIR and SWIR spectrum, and detecting the~~

~~muzzle flash in output of said PDA by applying a signal processing to pixel signals of said PDA.~~

~~18. A method for use in detection of a muzzle flash event, the method comprising sensing by a Photo Detector Array (PDA) electromagnetic radiation passed through a filter of electromagnetic radiation selectively passing a spectral range of low atmospheric transmission, and detecting the muzzle flash in output of said PDA by applying a signal processing to pixel signals of said PDA.~~

~~19. A method for use in detection of a muzzle flash event, the method comprising sensing electromagnetic radiation by a Photo Detector Array (PDA) sensitive in at least a portion of the NIR and SWIR spectrum, and selecting candidate pixels by applying a stage of processing to pixel signals of said PDA, said stage being configured to provide a stage data rate decrease factor smaller than a data rate decrease factor between an initial data rate of the PDA and an alarm rate benchmark of 100 alarms/s.~~

~~20. A method for use in detection of a muzzle flash event, the method comprising sensing by a Photo Detector Array (PDA) electromagnetic radiation passed through a filter of electromagnetic radiation selectively passing a spectral range of low atmospheric transmission, and selecting candidate pixels by applying a stage of processing to pixel signals of said PDA, said stage being configured to provide a stage data rate decrease factor smaller than a data rate decrease factor between an initial data rate of the PDA and an alarm rate benchmark of 100 alarms/s.~~

~~21. The method of Claim 19 or 20, said stage data rate decrease factor being smaller than 20 multiplied by a square root of the data rate decrease factor between the initial data rate of the PDA and said alarm rate benchmark.~~

~~22. The method of any one of Claims 17-21, the processing comprising comparing pixel signals of said PDA with a temporal-spatial signature of the muzzle flash.~~

~~23. The method of any one of Claims 17 to 22, the processing comprising eliminating spatial background portion from the pixel signals.~~

~~24. The method of any one of Claims 17 to 23, the processing comprising eliminating substantially slowly changing portions from the pixel signals.~~

~~25. The method of Claim 24, the eliminating comprising at least one differencing of the pixel signals.~~

~~26. The method of Claim 24, the eliminating comprising second order differencing of the pixel signals.~~

~~27. The method of any one of Claims 17 to 26, the processing comprising selecting pixel signals' portions substantially similar to a temporal signature of the muzzle flash.~~

~~28. The method of Claim 27, said selecting comprising selecting a pulse having a form of a peak.~~

~~29. The method of Claim 28, wherein said peak is of a predetermined duration.~~

~~30. The method of any one of Claims 17 to 29, the processing comprising an analog processing of time dependence of the pixel signals.~~

~~31. The method of Claim 30, wherein said analog processing comprises at least one differencing of the pixel signals.~~

~~32. The method of Claim 30, wherein said analog processing comprises second order differencing of the pixel signals.~~

5 ~~33. The method Claim 30, wherein said analog processing comprises passing the pixels signals through a matched filter, adapted to match the temporal signature of muzzle flash.~~

~~34. The method any one of Claims 30-33, said analog processing providing a voltage potential at an output, the voltage potential being indicative of an estimate of likelihood of a detection of the muzzle flash.~~

~~35. The method of any one of Claims 17 to 34, the processing comprising a parallel processing of time dependence of the pixel signals.~~

15 ~~36. The method of Claim 30-34, said analog processing being adapted to generate substantially estimates of likelihood that a respective to the estimate pixel has detected the muzzle flash.~~

~~37. The method of Claim 35, said parallel processing being adapted to generate substantially estimates of likelihood that a respective to the estimate pixel has detected the muzzle flash.~~

20 ~~38. The method of any one of Claims 17 to 37, the processing comprising a digital processing of time dependence of the pixel signals.~~

~~39. The method of Claim 38, said digital processing being adapted to generate substantially estimates of likelihood that a respective to the estimate pixel has detected the muzzle flash.~~

~~40. The method of any one of Claims 17 to 39, the processing comprising selecting candidate pixels by comparing, for a plurality of pixels, substantial estimates of likelihood that a respective to the estimate pixel has detected the muzzle flash with a likelihood threshold being common for a plurality of pixels.~~

5 ~~41. The method Claim 40, said threshold being the same within each of two or more groups of adjacent pixels and being different between said groups.~~

~~42. The method of any one of Claims 17 to 41, the processing comprising selecting candidate pixels by comparing, for at least one pixel, an estimate of likelihood that the pixel has detected the muzzle flash with a likelihood threshold, obtained using a replica of the pixel signals.~~

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~~43. The method of any one of Claims 17 to 42, comprising selecting substantially the same number of candidate pixels from subsequent PDA frames.~~

~~44. The method of any one of Claims 17 to 43, the method comprising utilizing at least two processing stages, a later of said stages applying a processing selecting candidate pixels to a smaller number of the PDA pixels than an earlier of said stages.~~

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~~45. The method of any one of Claims 17 to 44, the method comprising using at least two processing stages, a later of said stages selecting candidate pixels by utilizing more processing time per its candidate pixel than an earlier of said stages.~~

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~~46. The method of any one of Claims 17 to 45, the method comprising selecting into candidate pixels of pixels whose signals together with their vicinity pixels' signals present substantially a spatial signature of the muzzle flash.~~

~~47. The method of any one of Claims 17-46, the processing comprising suppressing selection into candidate pixels of a pixel whose signal together with its vicinity pixels' signals present substantially a temporal-spatial signature of a substantially moving light source.~~

5 ~~48. The method of any one of Claims 17-47, the processing comprising at least two stages, the processing at a later stage comprising confirming selection into candidate pixels of a candidate pixel whose likelihood estimate of having detected the muzzle flash has increased at the later stage of the processing.~~

10 ~~49. The method of Claim 48, said later stage of processing utilizing the candidate pixel's signal and candidate pixel's vicinity pixels' signals.~~

~~50. The method of any one of Claims 17-49, the processing comprising suppressing selection into candidate pixels of a pixel whose signal is not accompanied by a detection of an acoustic signal with an acoustic signature substantially similar to the acoustic signature of the muzzle flash-causing event.~~

15 ~~51. The method of any one of preceding Claims, the method comprising cooling of the PDA.~~

~~52. The method of Claim 51, the sensing being performed at a temperature between -30 °C and a PDA ambient temperature.~~

20 ~~53. The method of Claim 50, the sensing being performed at a temperature higher than a PDA ambient temperature.~~

~~54. The method of any one of Claims 1-50, the sensing being performed without cooling the PDA.~~

~~55. The method of any one of preceding Claims, the method comprising utilizing for said detection a power supply allowing more than 1 hour of said detection.~~

~~56. A method for use in detection of a muzzle flash event, the method comprising sensing, by a Photo Detector Array (PDA), sensitive in at least a portion of the NIR and SWIR spectrum, electromagnetic radiation, passed through a filter of electromagnetic radiation selectively passing in said portion a spectral range of low atmospheric transmission, the method comprising utilizing for said detection a power supply allowing from 1 to 24 hours of said detection.~~

~~57. The method of Claim 56, said power supply allowing more than 6 hours of said detection.~~

~~58. The method of Claim 55 or 56, said power supply allowing less than 12 hours of said detection.~~

~~59. The method of any one of preceding Claims, the method comprising utilizing for said detection a power supply of less than 10 Watts output power.~~

~~60. The method of any one of preceding Claims, the method utilizing for said detection only equipment portable by a human during said detection.~~

~~61. The method of Claim 60, a weight of said equipment being less than 3 kg.~~

~~62. The method of Claim 58, said power supply allowing more than 6 hours of said detection.~~

~~63. The method of any one of preceding Claims, the utilized sensing at least for a part being performed within the NIR spectrum.~~

~~64. The method of any one of preceding Claims, the utilized sensing at least for a part being performed within the SWIR spectrum.~~

~~65. The method of any one of preceding Claims, the PDA having a sensitivity maximum at a wavelength longer than 3 microns and a sensitivity cut-off at a wavelength shorter than 5 microns.~~

~~66. The method of any one of Claims 1-64, the PDA having a sensitivity maximum at a wavelength shorter than 3 microns.~~

~~67. The method of Claim 66, the PDA having a sensitivity cut-off at a wavelength shorter than 5 microns.~~

~~68. The method of Claim 66, the PDA having a sensitivity cut-off at a wavelength between 1.4 μm and 1.65 μm .~~

~~69. The method of Claim 66, the PDA having a sensitivity cut-off at a wavelength 1.65 μm and 1.8 μm .~~

~~70. The method of Claim 66, the PDA having a sensitivity cut-off at a wavelength between 1.3 μm and 2.5 μm .~~

~~71. The method of any one of preceding Claims, the PDA having a sensitivity maximum at a wavelength longer than 0.75 microns.~~

~~72. The method of any one of preceding Claims, the PDA having a region of a predominant sensitivity fully within the NIR/SWIR range, said region being a region where the sensitivity is higher than 20% of a maximum PDA's sensitivity.~~

~~73. The method of Claim 72, wherein the predominant sensitivity is higher than 35% of a maximum PDA's sensitivity.~~

~~74. The method of Claim 72, wherein the predominant sensitivity is higher than 50% of the maximum PDA's sensitivity.~~

~~75. The method of Claim 72, wherein the predominant sensitivity is higher than 70% of a maximum PDA's sensitivity.~~

~~76. The method of any one of preceding Claims, a per pixel field of view (FOV) of the PDA being between 0.1 and 0.2 degrees.~~

5 ~~77. The method of any one of Claims 1-75, a per pixel field of view (FOV) of the PDA being between 0.2 and 0.5 degrees.~~

~~78. The method of any one of Claims 1-75, a per pixel field of view (FOV) of the PDA being larger than 0.5 degrees.~~

10 ~~79. The method of any one of preceding Claims, a number of pixels of the PDA being more than 10,000.~~

~~80. The method of any one of preceding Claims, a number of pixels of the PDA being between 10,000 and 100,000.~~

~~81. The method of any one of Claims 1-79, a number of pixels of the PDA being between 100,000 and 1,000,000.~~

15 ~~82. The method of any one of Claims 1-79, a number of pixels of the PDA being suitably more than 1,000,000.~~

~~83. The method of any one of preceding Claims, a field of view of the PDA being between 30 and 50 degrees in at least one dimension.~~

20 ~~84. The method of any one of Claims 1-82, a field of view of the PDA being between 50 and 90 degrees in at least one dimension.~~

~~85. The method of any one of Claims 1-82, a field of view of the PDA being larger than 90 degrees in at least one dimension.~~

~~86.5. The method of any one of preceding Claims, wherein said filtering causes the sensingimaging to be being substantially within thea range of low~~

atmospheric light transmission at least partially including the trough situated around 1.15 μm (micron).

~~87.6.~~ The method of any one of preceding Claims, wherein said filtering causes the sensing being imaging to be substantially within thea range of low
 5 atmospheric light transmission at least partially including a trough extending from 1.34 μm to 1.50 μm .

~~88.7.~~ The method of any one of preceding Claims, wherein said filtering causes the sensing being imaging to be substantially within thea range of low
 10 atmospheric light transmission at least partially including a trough extending from 1.80 μm to 2.00 μm .

~~89.~~ The method of any one of preceding Claims, the sensing being substantially within a range of low atmospheric light transmission at least partially including a trough extending from 2.50 μm to 2.90 μm .

~~90.~~ The method of any one of preceding Claims, the PDA being a CMOS
 15 PDA.

~~91.~~ The method of any one of preceding Claims, the PDA being an intracavity PDA.

~~92.~~ The method of any one of preceding Claims, an integration time of the sensing being between 10^{-2} s and $5.0 \cdot 10^{-3}$ s.

~~93.~~ The method of any one of Claims 1-91, an integration time of the sensing being between $5.0 \cdot 10^{-3}$ s and $2.0 \cdot 10^{-3}$ s.
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~~94.~~ The method of any one of Claims 1-91, an integration time of the sensing being between $2.0 \cdot 10^{-3}$ s and $5.0 \cdot 10^{-4}$ s.

~~95. The method of any one of Claims 1-91, an integration time of the sensing being between $5.0 \cdot 10^{-4}$ s and 10^{-4} s.~~

~~96. The method of any one of preceding Claims, comprising compressing a replica of pixel signals of said PDA before the recording.~~

5 8. The method of any one of preceding Claims, wherein said filtering allows less than 10% of the energy of wavelengths outside said spectral range of low atmospheric transmission to be sensed by the PDA.

10 9. The method of any one of preceding Claims, wherein said filtering allows less than 2% of the energy of wavelengths outside said spectral range of low atmospheric transmission to be sensed by the PDA.

15 10. A device for use in detection and location of a muzzle flash event, the device comprising an imager comprising a Photo Detector Array (PDA), sensitive in at least a portion of the NIR and SWIR spectrum, and a filter of electromagnetic radiation configured and operable to selectively passing therethrough in said portion a spectral range of bands corresponding to relatively low atmospheric transmission, the PDA having of the electromagnetic radiation in atmosphere for said at least a portion of the SWIR spectrum, wherein said PDA is not cryogenically cooled, whereby said imager provides for both detecting and locating a muzzle flash event. an integration time shorter
20 than a duration of the muzzle flash event.

11. The device of claim 10, wherein the PDA has an integration time shorter than 10^{-2} s.

~~97-12. The device of claim 10 or 11, wherein said PDA comprises at least 10,000 pixels.~~

~~98. A device for use in detection of a muzzle flash event, the device comprising a Photo Detector Array (PDA), sensitive in at least a portion of the NIR and SWIR spectrum, and a filter of electromagnetic radiation selectively passing in said portion a spectral range of low atmospheric transmission, said sensing having an integration time shorter than 10^{-2} s.~~

~~99. A device for use in detection of a muzzle flash event, the device comprising a Photo Detector Array (PDA), a filter of electromagnetic radiation selectively passing a spectral range of low atmospheric transmission, and optics adapted to focus at least said spectral range on said PDA, a per pixel field of view (FOV) of said PDA being larger at the focusing distance than said muzzle flash.~~

~~100. The device of Claim 99, wherein said focusing distance is larger than 50 m.~~

~~101. A device for use in detection of a muzzle flash event, the device comprising a Photo Detector Array, a filter of electromagnetic radiation selectively passing a spectral range of low atmospheric transmission, and optics adapted to focus at least said spectral range on said PDA, a per pixel field of view (FOV) of said PDA being larger than 0.1 degrees.~~

~~102. The device of Claim 99, 100 or 101, wherein said Photo Detector Array is sensitive in at least a portion of the NIR and SWIR spectrum.~~

~~103.13. AThe device of claims 10-12, wherein said for use in detection of a muzzle flash event, the device comprising a Photo Detector Array (PDA) sensitive in at least a portion of the NIR and SWIR spectrum, the device~~

adapted to operate with has a dead time shorter than a duration of the muzzle flash event.

~~104. The device of Claim 103, wherein said dead time is shorter than the one tenth of said duration.~~

5 ~~105. A device for use in detection of a muzzle flash event, the device comprising a Photo Detector Array (PDA) sensitive in at least a portion of the NIR and SWIR spectrum, the device adapted to operate with a dead time shorter than one millisecond.~~

10 ~~106. The device of any one of Claims 103-105, comprising a shutter allowing an operation with said dead time.~~

~~107. The device of Claim 106, wherein said shutter is an electronic shutter.~~

~~108. The device of any one of Claims 103-107, comprising a shutter controller for operating a shutter with said dead time.~~

15 ~~109. The device of Claim 108, wherein said shutter controller utilizes a rolling shutter scheme for operating the shutter.~~

~~110. A device for use in detection of a muzzle flash event, the device comprising a Photo Detector Array (PDA) sensitive in at least a portion of the NIR and SWIR spectrum and a multiplexer, adapted to divide pixel signals~~
20 ~~originating from said PDA into at least two replicas.~~

~~111. A device for use in detection of a muzzle flash event, the device comprising a Photo Detector Array (PDA), a filter of electromagnetic radiation selectively passing a spectral range of low atmospheric transmission, and a~~

multiplexer, adapted to divide pixel signals originating from said PDA into at least two replicas.

~~112. The device of Claim 110 or 111, comprising a memory for storing a replica of the pixel signals.~~

5 ~~113. A device for use in detection of a muzzle flash event, the device comprising a Photo Detector Array (PDA) sensitive in at least a portion of the NIR and SWIR spectrum, a filter of electromagnetic radiation selectively passing in said portion a spectral range of low atmospheric transmission, said PDA having a fill factor larger than 60%.~~

10 ~~114. The device of Claim 113, the fill factor being between 60% and 75%.~~

~~115. The device of Claim 113, the fill factor being between 75% and 90%.~~

~~116. The device of Claim 113, the fill factor being higher than 90%.~~

15 ~~117. A device for use in detection of a muzzle flash event, the device comprising a Photo Detector Array (PDA) sensitive in at least a portion of the NIR and SWIR spectrum, and a processing unit adapted to detect the muzzle flash in output of said PDA by applying a signal processing to pixel signals of said PDA.~~

20 ~~118. A device for use in detection of a muzzle flash event, the device comprising a Photo Detector Array (PDA), a filter of electromagnetic radiation selectively passing a spectral range of low atmospheric transmission, and a processing unit adapted to detect the muzzle flash in output of said PDA.~~

~~119. A device for use in detection of a muzzle flash event, the device comprising a Photo Detector Array (PDA), sensitive in at least a portion of the NIR and SWIR spectrum, and a processing unit comprising at least one stage of processing adapted to select candidate pixels by applying said stage to pixel signals of said PDA, said stage being configured to provide a stage data rate decrease factor smaller than a data rate decrease factor between an initial data rate of the PDA and an alarm rate benchmark of 100 alarms/s.~~

~~120. A device for use in detection of a muzzle flash event, the device comprising a Photo Detector Array (PDA), a filter of electromagnetic radiation selectively passing a spectral range of low atmospheric transmission, and a processing unit comprising at least one stage of processing adapted to select candidate pixels by applying said stage to pixel signals of said PDA, said stage being configured to provide a stage data rate decrease factor smaller than a data rate decrease factor between an initial data rate of the PDA and an alarm rate benchmark of 100 alarms/s.~~

~~121. The device of Claim 119 or 120, said stage data rate decrease factor being smaller than 20 multiplied by a square root of the data rate decrease factor between the initial data rate of the PDA and the alarm rate benchmark.~~

~~122. The device of any one of Claims 117-121, the processing unit adapted to compare pixel signals of said PDA with a temporal-spatial signature of the muzzle flash.~~

~~123. The device of any one of Claims 117 to 122, the processing unit adapted to eliminate a spatial background portion from the pixel signals.~~

~~124. The device of Claim 123, the processing unit adapted to generate scene motion vectors.~~

~~125. The device of any one of Claims 117 to 124, the processing unit adapted to eliminate substantially slowly changing portions from the pixel signals.~~

~~126. The device of Claim 125, the processing unit configured to perform the elimination using at least one differencing of the pixel signals.~~

~~127. The device of Claim 125, the processing unit configured to perform the elimination using a second order differencing of the pixel signals.~~

~~128. The device of any one of Claims 117 to 127, the processing unit adapted to select pixel signals' portions substantially similar to a temporal signature of the muzzle flash.~~

~~129. The device of Claim 128, the temporal signature having a form of a peak.~~

~~130. The device of Claim 129, wherein said peak is of a predetermined duration.~~

~~131. The device of any one of Claims 117 to 130, said processing unit being at least partially in-pixel.~~

~~132. The device of any one of Claims 117 to 131, the processing unit comprising an analog processing unit adapted to process time dependence of the pixel signals.~~

~~133. The device of Claim 132, wherein said analog processing unit comprising a circuit adapted to perform at least one differencing of the pixel signals.~~

~~134. The device of Claim 133, wherein said analog processing unit comprising a circuit adapted to perform second order differencing of the pixel signals.~~

~~135. The device of Claim 132, wherein said analog processing unit comprises a matched filter, adapted to match the temporal signature of muzzle flash.~~

~~136. The device any one of Claims 132-135, said analog processing unit adapted to provide a voltage potential at outputs, the voltage potential being indicative of an estimate of likelihood of a detection of the muzzle flash.~~

~~137. The device of any one of Claims 117 to 136, the processing unit comprising a parallel processing unit processing time dependence of the pixel signals.~~

~~138. The device of Claim 132-136, said analog processing unit adapted to generate substantially estimates of likelihood that a respective to the estimate pixel has detected the muzzle flash.~~

~~139. The device of Claim 137, said parallel processing unit being adapted to generate substantially estimates of likelihood that a respective to the estimate pixel has detected the muzzle flash.~~

~~140. The device of any one of Claims 117 to 139, the processing unit comprising a digital processing unit processing time dependence of the pixel signals.~~

~~141. The device of Claim 140, said digital processing unit adapted to generate substantially estimates of likelihood that a respective to the estimate pixel has detected the muzzle flash.~~

~~142. The device of any one of Claims 117 to 141, the processing unit adapted to select candidate pixels by comparing, for a plurality of pixels, substantial estimates of likelihood that a respective to the estimate pixel has detected the muzzle flash with a likelihood threshold being common for a plurality of pixels.~~

~~143. The device of Claim 142, said threshold being the same within each of two or more groups of adjacent pixels and being different between said groups.~~

~~144. The device of any one of Claims 117 to 143, the processing unit adapted to select candidate pixels by comparing, for at least one pixel, an estimate of likelihood that the pixel has detected the muzzle flash with a likelihood threshold, obtained using a replica of the pixel signals.~~

~~145. The device of any one of Claims 117 to 144, the processing unit adapted to select substantially the same number of candidate pixels from subsequent PDA frames.~~

~~146. The device of any one of Claims 117 to 145, the device comprising at least two processing stages, a later of said stages configured to apply a processing selecting candidate pixels to a smaller number of the PDA pixels than an earlier of said stages.~~

~~147. The device of any one of Claims 117 to 146, the device comprising at least two processing stages, a later of said stages configured to select candidate pixels by utilizing more processing time per its candidate pixel than an earlier of said stages.~~

~~148. The device of any one of Claims 117 to 147, the processing unit adapted to select into candidate pixels those pixels whose signals together with their vicinity pixels' signals present substantially a spatial signature of the muzzle flash.~~

5 ~~149. The device of any one of Claims 117-148, the processing unit adapted to suppress selection into candidate pixels of a pixel whose signal together with its vicinity pixels' signals present substantially a temporal-spatial signature of an unsuitably moving light source.~~

10 ~~150. The device of any one of Claims 117-149, the processing unit comprising at least two processing stages, a later stage of said stages adapted to confirm selection into candidate pixels of a candidate pixel whose likelihood estimate of having detected the muzzle flash has increased at the later stage of the processing.~~

15 ~~151. The device of Claim 150, said later stage of processing utilizing the candidate pixel's signal and candidate pixel's vicinity pixels' signals.~~

~~152. The device of any one of Claims 117-151, the processing unit adapted to suppress selection into candidate pixels of a pixel whose signal is not accompanied by a detection of an acoustic signal with an acoustic signature substantially similar to the acoustic signature of the muzzle flash-causing event.~~

20 ~~153. The device of any one of preceding device Claims, the device comprising a cooler for said PDA.~~

~~154. The device of Claim 153, the cooler enabling sensing at a temperature lower than a PDA ambient temperature.~~

~~155. The device of any one of Claims 97-152, the device configured without a cooler for the PDA.~~

~~156. The device of any one of preceding device Claims, the device comprising a power supply allowing more than 1 hour of said detection.~~

5 ~~157. A device for use in detection of a muzzle flash event, the device comprising a Photo Detector Array (PDA), sensitive in at least a portion of the NIR and SWIR spectrum, and a filter of electromagnetic radiation selectively passing in said portion a spectral range of low atmospheric transmission, the device comprising a power supply allowing from 1 to 24 hours of said detection.~~

10 ~~158. The device of Claim 157, said power supply allowing more than 6 hours of said detection.~~

~~159. The device of Claim 156 or 157, said power supply allowing less than 12 hours of said detection.~~

15 ~~160. The device of any one of preceding device Claims, the device comprising a power supply of less than 10 Watts output power.~~

~~161. The device of any one of preceding device Claims, the device being portable by a human during said detection.~~

~~162. The device of Claim 161, the device weighing less than 3 kg.~~

20 ~~163. The device of Claim 162, said power supply allowing more than 6 hours of said detection.~~

~~164. The device of any one of preceding device Claims, the PDA at least partially being sensitive within the NIR spectrum.~~

~~165. The device of any one of preceding device Claims, the PDA at least partially being sensitive within the SWIR spectrum.~~

~~166. The device of any one of preceding device Claims, the PDA having a sensitivity maximum at a wavelength longer than 3 microns and a sensitivity cut-off at a wavelength shorter than 5 microns.~~

~~167. The device of any one of Claims 97-166, the PDA having a sensitivity maximum at a wavelength shorter than 3 microns.~~

~~168.14. The device of any one of Claims 10-13167, wherein the PDA hasing a sensitivity cut-off at a wavelength between 1.4 μ m and 2.5 μ m shorter than 5 microns.~~

~~169. The device of Claim 168, the PDA having a sensitivity cut-off at a wavelength between 1.4 μ m and 1.65 μ m.~~

~~170. The device of Claim 168, the PDA having a sensitivity cut-off at a wavelength 1.65 μ m and 1.8 μ m.~~

~~171. The device of Claim 168, the PDA having a sensitivity cut-off at a wavelength between 1.8 μ m and 2.5 μ m.~~

~~172. The device of any one of preceding device Claims, the PDA having a sensitivity maximum at a wavelength longer than 0.75 microns.~~

~~173. The device of any one of preceding Claims, the PDA having a region of a predominant sensitivity fully within the NIR/SWIR range, said region being a region where the sensitivity is higher than 20% of a maximum PDA's sensitivity.~~

~~174. The device of Claim 173, wherein the predominant sensitivity is higher than 35% of a maximum PDA's sensitivity.~~

~~175. The device of Claim 173, wherein the predominant sensitivity is higher than 50% of the maximum PDA's sensitivity.~~

~~176. The device of Claim 173, wherein the predominant sensitivity is higher than 70% of a maximum PDA's sensitivity.~~

~~177. The device of any one of preceding device Claims, a per pixel field of view (FOV) of the PDA being between 0.1 and 0.2 degrees.~~

5 ~~178. The device of any one of Claims 97-176, a per pixel field of view (FOV) of the PDA being between 0.2 and 0.5 degrees.~~

~~179. The device of any one of Claims 97-176, a per pixel field of view (FOV) of the PDA being larger than 0.5 degrees.~~

10 ~~180. The device of any one of preceding device Claims, a number of pixels of the PDA being more than 10,000.~~

~~181. The device of any one of preceding device Claims, a number of pixels of the PDA being between 10,000 and 100,000.~~

~~182. The device of any one of Claims 97-180, a number of pixels of the PDA being between 100,000 and 1,000,000.~~

15 ~~183. The device of any one of Claims 97-180, a number of pixels of the PDA being suitably more than 1,000,000.~~

~~184. The device of any one of preceding device Claims, a field of view of the PDA being between 30 and 50 degrees in at least one dimension.~~

20 ~~185. The device of any one of Claims 97-183, a field of view of the PDA being between 50 and 90 degrees in at least one dimension.~~

~~186. The device of any one of Claims 97-183, a field of view of the PDA being larger than 90 degrees in at least one dimension.~~

~~187.15. The device of any one of preceding device Claims 10-14, wherein said filter causes said PDA the device adapted to sense~~

electromagnetic radiation substantially within a range of low atmospheric light transmission at least partially including the trough situated around 1.15 μm (micron).

5 ~~188.16.~~ The device of any one of preceding device Claims 10-15,
 wherein said filter causes said PDA the device adapted to sense
 electromagnetic radiation substantially within a range of low atmospheric light
 transmission at least partially including a trough extending from 1.34 μm to 1.50
 μm .

10 ~~189.17.~~ The device of any one of preceding device Claims 10-16,
 wherein said filter causes said PDA the device adapted to sense
 electromagnetic radiation substantially within a range of low atmospheric light
 transmission at least partially including a trough extending from 1.80 μm to 2.00
 μm .

15 ~~190.~~ The device of any one of preceding device Claims, the device
 ~~adapted to sense electromagnetic radiation substantially within a range of low~~
 ~~atmospheric light transmission at least partially including a trough extending~~
 ~~from 2.50 μm to 2.90 μm .~~

~~191.~~ The device of any one of preceding device Claims, the PDA being
 ~~a CMOS PDA.~~

20 ~~192.~~ The device of any one of preceding device Claims, the PDA being
 ~~an intracavity PDA.~~

~~193.~~ The device of any one of preceding device Claims, an integration
 ~~time of the PDA sensing being between 10^{-2} s and $5.0 \cdot 10^{-3}$ s.~~

~~194. The device of any one of Claims 97-193, an integration time of the PDA sensing being between $5.0 \cdot 10^{-3}$ s and $2.0 \cdot 10^{-3}$ s.~~

~~195. The device of any one of Claims 97-193, an integration time of the PDA sensing being between $2.0 \cdot 10^{-3}$ s and $5.0 \cdot 10^{-4}$ s.~~

5 ~~196. The device of any one of Claims 97-193, an integration time of the PDA sensing being between $5.0 \cdot 10^{-4}$ s and 10^{-4} s.~~

~~197. The device of any one of preceding device Claims, the device comprising a compressing unit adapted to compress a replica of pixel signals of said PDA before the recording them into a memory.~~

10 ~~198. A device for use in muzzle flash detection, the device comprising a Photo Detector Array (PDA), having a cutoff wavelength shorter than 3 microns, and a processing unit adapted to detect muzzle flash events in an output of said PDA.~~

15 ~~199. The device of Claim 198, comprising a filter of electromagnetic radiation selectively passing in the PDA's sensitivity band a spectral range of low atmospheric transmission.~~

~~200. The device of Claim 199, wherein said filter passes less than 50% of energy of wavelengths being outside said spectral range of low atmospheric transmission and sensed by the PDA.~~

20 ~~201. The device of Claim 199, wherein said filter passes less than 25% of energy of wavelengths being outside said spectral range of low atmospheric transmission and sensed by the PDA.~~

~~202.18.~~ The device of any one of Claims 10-17~~499~~, wherein said filter allowspasses less than 10% of energy of wavelengths being outside said spectral range of low atmospheric transmission to be~~and~~ sensed by the PDA.

~~203.19.~~ The device ~~of~~ of any one of preceding device Claims 10-18,
 5 wherein said filter allowspasses less than 2% of energy of wavelengths being outside said spectral range of low atmospheric transmission to be~~and~~ sensed by the PDA.

~~204.~~ ~~The device of any one of Claims 199-203 having at at least one wavelength of said spectral range a sensitivity being between 50% and 75% of the sensitivity of the PDA.~~

~~205.~~ ~~The device of any one of Claims 199-203 having at at least one wavelength of said spectral range a sensitivity larger than 75% of the sensitivity of the PDA.~~

~~206.~~ ~~A processing unit for use in detection of a muzzle flash event, said processing unit being adapted to process pixel signals originating from a PDA and to generate substantially likelihoods of muzzle flash detection for pixels of the PDA, the processing unit comprising a multiplexer dividing the pixel signals between at least two branches.~~

~~207.~~ ~~A processing unit for use in detection of a muzzle flash event, said processing unit being substantially as described herein with reference to the specification.~~

~~208.~~ ~~A device for use in detection of a muzzle flash event, said device being substantially as described herein with reference to the specification.~~

~~209. A method for use in detection of muzzle flash, said method being substantially as described herein with reference to the specification.~~