

CLAIMS

1. A method (10) for detecting microscopic objects of foreign origin present in a fluid by utilizing first, second, and third image data originating from first, second, and third digital image frames, respectively, captured sequentially in time by an image sensor receiving light propagated across a sample volume containing a fluid possibly comprising moving microscopic objects of foreign origin while illuminating the sample volume by coherent light, whereby the possible microscopic objects scatter part of the light, the scattered and non-scattered light interfering so as to form interference fringes behind the microscopic objects, each image data comprising, for a moving microscopic object of foreign origin present in the sample volume at the time of capture of the associated digital image frame, a hologram pattern with spatially alternating intensity formed by the interference fringes (11), the method comprising:

obtaining first differential image data comprising the difference of the first and the second image data, the first differential image data comprising, for each hologram pattern present in the first or second image data, a differential pattern (13a);

obtaining second differential image data comprising the difference of the second and the third image data, the second differential image data comprising, for each hologram pattern present in the second or third image data, a differential pattern (13b);

automatically generating product of difference (POD) image data comprising the product of the first and the second differential image data, the POD image data comprising, for each hologram pattern

present in the second image data, a product pattern (14); and

5 automatically detecting the presence of moving microscopic object(s) of foreign origin in the sample volume on the basis of product pattern(s) present in the POD image data (17).

2. A method (10) as defined in claim 1, comprising automatically processing the first, second, and third
10 digital image frames so as to provide shading correction therein (12).

3. A method as defined in claim 1 or 2, further comprising automatically determining at least one
15 shape parameter of a detected microscopic object of foreign origin on the basis of shape of the associated product pattern present in the POD image data or shape of the associated differential pattern present in the first or second differential image data, respectively
20 (18a).

4. A method as defined in any of claims 1 to 3, further comprising automatically determining at least one position parameter of a detected microscopic
25 object on the basis of position of the associated product pattern in the POD image data or position of the associated differential pattern present in the first or second differential image data, respectively (18b).

30 5. A method as defined in any of claims 1 to 4, further comprising automatically identifying, for a product pattern present in the POD image data, associated differential pattern present in the first
35 or the second differential image data, and automatically determining at least one size parameter of the associated microscopic object of foreign origin

on the basis of amplitude of the spatially alternating intensity of the associated differential pattern (18c).

5 6. A method (50) as defined in any of claims 1 to 5, further comprising, before detecting the presence of moving microscopic object(s) of foreign origin:

10 automatically generating sum of difference (SOD) image data comprising the sum of the first and the second differential image data, the SOD image data comprising, for each hologram pattern present in the first or the third image data, a sum pattern (55); and
15 automatically filtering the POD image data on the basis of the SOD image data so as to set the absolute value of the spatially alternating intensity of the POD image data at the location of a possible sum pattern present in the SOD image data below or at a limit value (56).

20 7. A method (70) as defined in any of claims 1 to 6, wherein the method comprises obtaining the first, second, and third image data (71), said obtaining comprising:

25 providing coherent light (711);
illuminating a sample volume containing a fluid possibly comprising moving microscopic objects of foreign origin by the coherent light, whereby the possible microscopic objects scatter part of the light, the scattered and non-scattered light
30 interfering so as to form interference fringes behind the microscopic objects (712); and

capturing the first, second, and third digital image frames by an image sensor receiving the light propagated across the sample volume (713).

35 8. An apparatus (800) for detecting microscopic objects (816) of foreign origin present in a fluid,

the apparatus comprising a computing arrangement (885) configured to perform the operations of the method as defined in any of claims 1 to 6.

- 5 9. An apparatus (900) as defined in claim 8, further comprising measurement arrangement (990) comprising:
a cuvette (991) defining a sample volume for receiving a fluid (992) possibly comprising moving microscopic objects (916) of foreign origin;
10 an illuminating arrangement (993) configured to emit coherent light (994) and illuminate fluid received in the sample volume by the coherent light, whereby the possible microscopic objects (916) scatter part of the light, the scattered and non-scattered
15 light interfering so as to form interference fringes behind the microscopic objects; and
an image sensor (995) positioned and configured to capture digital image frames by receiving the light propagated across the sample
20 volume;
the computing arrangement (985) being connected to the measurement arrangement to receive image data (910, 920, 930) of the digital image frames.
- 25 10. An apparatus (900) as defined in claim 9, wherein the cuvette (991) is of flow-through type.
11. A computer program product comprising program code instructions which, when executed by a processor,
30 cause the processor to perform the method as defined in any of claims 1 - 6.
12. A computer program product as defined in claim 11, stored on a computer-readable medium.