

CLAIMS

1. A method (10) for detecting microscopic objects of foreign origin present in a fluid, the method comprising:
- 5 obtaining (101) prepared image data originating from a hologram digital image frame captured by an image sensor receiving light propagated across a sample volume, containing a fluid possibly comprising 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, the prepared image data comprising, for a microscopic object, a prepared hologram pattern with prepared spatially alternating intensity formed by the interference fringes;
- 10 providing (102) filtered image data, comprising automatically filtering the prepared image data by an edge enhancing filter, the filtered image data comprising, for a prepared hologram pattern present in the prepared image data, a filtered hologram pattern; and
- 15 automatically detecting (103), on the basis of the filtered hologram pattern, the presence of the microscopic object associated with the filtered hologram pattern in the sample volume of the fluid.
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2. A method as defined in claim 1, wherein the edge enhancing filter is a symmetric filter.
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3. A method as defined in claim 1 or 2, wherein the prepared image data is filtered by the edge enhancing filter at least in two different directions.
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4. A method (10) as defined in any of claims 1 to 3,
further comprising automatically determining (104) at
least one shape parameter of a detected microscopic
object on the basis of shape of the associated
5 filtered hologram pattern.
5. A method as defined in any of claims 1 to 4,
further comprising automatically determining at least
one position parameter of a detected microscopic
10 object on the basis of position of the associated
filtered hologram pattern in the filtered image data.
6. A method (10) as defined in any of claims 1 to 5,
further comprising automatically identifying (105),
15 for a filtered hologram pattern, the associated
prepared hologram pattern in the prepared image data,
and automatically determining at least one size
parameter of the associated microscopic object on the
basis of amplitude of the prepared spatially
20 alternating intensity of the associated prepared
hologram pattern.
7. A method (20) as defined in any of claims 1 to 6,
wherein obtaining the prepared image data comprises
25 obtaining (211) initial image data of the hologram
digital image frame, the initial image data
comprising, for a microscopic object, an initial
hologram pattern with initial spatially alternating
intensity component; and automatically scaling down
30 (212) amplitude values of the initial spatially
alternating intensity component of the initial
hologram patterns exceeding a predetermined limit.
8. A method (10) as defined in any of claims 1 to 7,
35 wherein filtering the prepared image data by an edge
enhancing filter comprises applying a convolution
kernel to the prepared image data.

9. A method (10) as defined in any of claims 1 to 8,
wherein filtering the prepared image data by an edge
enhancing filter is carried out for at least two
5 different spatial frequencies.

10. A method as defined in claim 3 or 9, wherein
providing the filtered image data comprises providing
a plurality of filtered image frames each comprising
10 partial filtered image data, and combining the partial
filtered image data of the plurality of filtered image
frames into the filtered image data.

11. A method (10) as defined in any of claims 1 to 10,
15 the filtering the prepared image data initially
producing, for a prepared hologram pattern, filtered
spatially alternating intensity component with
positive and negative values, wherein providing the
filtered image data further comprises automatically
20 converting the negative values into their absolute
values.

12. A method as defined in claim 11, wherein providing
the filtered image data further comprises
25 automatically smoothing the filtered spatially
alternating intensity component.

13. A method (30) as defined in any of claims 1 to 12,
the fluid flowing in the sample volume, wherein
30 obtaining the prepared image data comprises:

obtaining (311) initial image data of two
hologram digital image frames captured sequentially
in time;

35 automatically detecting (312), on the basis
of the initial image data of the two hologram digital
image frames, presence of any stationary scattering
object on the basis of presence of stationary hologram

patterns appearing similarly in the image data of the two hologram digital image frames; and

automatically generating (313) the prepared image data on the basis of at least one of the initial
5 image data from which any stationary hologram detected is removed.

14. A method (40) as defined in any of claims 1 to 13, wherein obtaining the prepared image data comprises:

10 providing (41) coherent light;
illuminating (42) a sample volume containing a fluid possibly comprising microscopic objects of foreign origin by the coherent light, whereby the possible microscopic objects scatter part of the
15 light, the scattered and non-scattered light interfering so as to form interference fringes behind the microscopic objects; and

capturing (43) a hologram digital image frame by an image sensor receiving the light propagated
20 across the sample volume.

15. An apparatus (800) for detecting microscopic objects (816) of foreign origin present in a fluid, the apparatus comprising a computing arrangement (810)
25 configured to perform the operations of the method as defined in any of claims 1 to 12.

16. An apparatus (900) as defined in claim 15, further comprising measurement arrangement (940) comprising:

30 a cuvette (941) defining a sample volume for receiving a fluid (942) possibly comprising microscopic objects (916) of foreign origin;

an illuminating arrangement (950) configured to emit coherent light (951) and illuminate fluid
35 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

light interfering so as to form interference fringes behind the microscopic objects; and

an image sensor (960) positioned and configured to capture a hologram digital image frame (970) by receiving the light propagated across the sample volume;

the computing arrangement (910) being connected to the measurement arrangement to receive image data of the hologram digital image frame (970).

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17. An apparatus (900) as defined in claim 16, wherein the cuvette (941) is of flow-through type.

18. A computer program product comprising program code instructions which, when executed by a processor, cause the processor to perform the method according to any of claims 1 - 13.

19. A computer program product as defined in claim 18, stored on a computer-readable medium.

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