Claims

1. A system for observing one or more moving objects within a liquid sample, the system comprising:

a microscope for forming images of the liquid sample, the images being of respective layers of the liquid sample, the layers being transverse to an optic axis of the microscope and relatively displaced from each other parallel to the optic axis;

a camera for capturing images formed by the microscope;

a localizer arranged to analyze the captured images, and, using a set of previously stored locations for each of the respective objects, to update the set of locations for the respective objects, and

a controller for generating control signals based on the updated locations for varying the portion of the liquid sample which is imaged by the microscope, whereby the system is operated repeatedly to vary the portion of the liquid sample which is imaged by the microscope to track the one or more objects.

2. A system according to claim 1 ~~further including a controller for generating control signals based on the updated locations~~, the control signals being for controlling the relative positions of the microscope and a platform for supporting the liquid sample~~, to vary the portion of the liquid sample which is imaged by the microscope~~.

3. A system according to claim ~~2~~1 in which the controller is arranged to identify a region of interest in the liquid sample using the updated locations, and said control signals include signals for controlling the focus of the microscope to capture images of layers of the liquid sample corresponding to said region of interest.

4. A system according to claim 1~~, claim 2 or claim 3~~ in which the localizer includes an object identifier for identifying portions of the captured images

corresponding to the objects, a feature extraction unit for extracting features of the identified portions of the images, and a classifier for updating the set of stored locations based on the features.

5. A system according to claim 4 in which the object identifier seeks local intensity maxima in the images.

6. A system according to claim 5 in which, prior to seeking the intensity maxima, the object identifier processes the captured images with a Sobel operator and/or a Gaussian blur.

7. A system according to ~~any of~~ claim~~s~~ 4 ~~to 6~~ in which the feature extraction unit performs wavelet transformations in regions of the captured images selected based on the identified portions of the images.

8. A system according to claim 7 in which the regions are bands encircling the identified portions of the images, the bands being selected based on contours having equal intensity in the captured images.

9. A system according to claim 7 ~~or claim 8~~ in which the feature extraction unit generates, for each identified position of the image, a respective data-set encoding the results of the wavelet transformations at multiple wavelet levels.

10. A ~~method~~ system according to ~~any of~~ claim~~s~~ 4 ~~to 9~~ in which the classifier uses ~~a~~ an online machine learning algorithm.

11. A ~~method~~ system according to ~~any preceding~~ claim 1 in which the microscope is a phase contrast microscope.

12. A method of observing one or more moving objects within a liquid sample, the method comprising:

(a) capturing microscopy images of the liquid sample, the images being of respective layers of the liquid sample, the layers being transverse to an optic axis of the microscope and relatively displaced from each other parallel to the optic axis;

(b) analyzing the captured images, and, using a set of previously stored locations for each of the respective objects, to update the set of locations for the respective objects;

(c) generating control signals, based on the updated locations, for varying the portion of the liquid sample which is imaged by the microscope;

the method further including repeating steps (a) and (b) at least once using the set of updated locations in place of the set of previously stored locations;

whereby the portion of the liquid sample which is imaged by the microscope is varied to track the one or more objects.

13. A method according to claim 12 further including~~, based on the updated locations,~~ controlling the relative positions of the microscope and platform based on the control signals.~~, to vary the portion of the liquid sample which is imaged by the microscope.~~

14. A method according to claim 13 including identifying a region of interest in the liquid sample using the updated locations, and controlling the focus of the microscope to capture images of layers of the liquid sample corresponding to said region of interest.

15. A method according to~~ any of~~ claim~~s 11~~ 12 ~~to 13~~ in which said objects are cells or cell spheres, the method further including analyzing regions of the captured images including the updated locations, to study changes in the cells or cell spheres.