

analyzing the type and/or requirements of the cell but also analyzing the outside (the surrounding environment and the like) of the cell.

[0018]

When cell-analysis processing is performed, a cell-image input unit 41, a feature-group information generating unit 42, a noise removing unit 43, an analytical-model generating unit 44, a cell-evaluation information acquiring unit 45, an evaluation-target information acquiring unit 46, an analysis unit 47, and an output-information generating unit 48 mainly function in the CPU 11 as shown in Fig. 2. Further, feature-group information DB 61, cell evaluation DB 62, and an analytical-model retention unit 63 are provided in one region of the storage unit 18.

[0019]

The cell-image input unit 41 is configured to input the data of a cell image. Here, there is no particular limitation for the source of a cell image, but it may be the external apparatus 81 connected via the Internet and the like (not shown), or it may be the pre-processing apparatus 82 under control of an administrator or others of the cell analysis apparatus 1. That is, a person who provides a cell image, who is hereinafter referred to as a "user", may operate the external apparatus 81 to provide the data of a cell image for the cell analysis apparatus 1 via the Internet and the like in a case where the user does not have the cell analysis

different requirements, and the like are generated using one or more sample data sets of different types and different structures depending on each of analysis items, analysis approaches, different requirements, and the like. Each of these analytical models is linked with the information about the type and structure of each sample data set, and retained in the analytical-model retention unit 63.

[0038]

It is noted that once feature-group information about a new cell image is stored in the feature-group information DB 61, the analytical models retained in the analytical-model retention unit 63 are appropriately renewed by the analytical-model generating unit 44 at a subsequent proper timing.

[0039]

The cell-evaluation information acquiring unit 45 is configured to acquire evaluation-target information corresponding to a cell image from the external apparatus 81 and/or the cell adjustment unit 71 of the pre-processing apparatus 82, and store it in the cell evaluation DB 62. The evaluation-target information corresponding to a cell image includes information about results from destructive cell evaluation performed on a cell population (for example, a cell population in a predetermined container) as an imaging subject for that cell image by a predetermined evaluation method. That is, the evaluation-target information represents information from analytical evaluation of a predetermined cell population

of effective feature quantities among the feature quantities of a cell population. In the example of Fig. 10, a cell population of the same type is assumed to be cultured in a predetermined container, and the number of cells is assumed to increase over time. That is, in Fig. 10, it appears that only one cell is shown in a cell image Ga, and only two cells are shown in a cell image Gb, and only four cells are shown in a cell image Gc. However, as a matter of course, the cell population is actually contained in the predetermined container as shown in the cell image G of Fig. 11. That is, the cells in Fig. 10 are not intended to represent individual cells, but to represent the rate (=1:2:4) of increase per hour. [0075]

Feature-group information Ia is obtained from the cell image Ga captured at a first time point. The feature-group information Ia includes at least three morphological feature quantities: the shape, movement, and surface of each cell and the population information of the cell population as the N types of feature parameters (elements). Here, examples of "population information" include statistical values such as the average value and the variance value, bin values of a histogram, and the like. For example, numerical data Ika obtained from a histogram for the "shape" of a cell population, numerical data Iua obtained from a histogram for the "movement" of the cell population, and numerical data Iha obtained from a histogram for the "surface" of the cell

each of the feature-group information Ia to Ic may be rearranged or combined with the feature-group information of the above other cell images in the multiple-image feature-group information generating unit 92, and the resulting first unit of feature-group information is accumulated in the first feature-group information accumulating unit 102. The heterogeneous information adding unit 93 will be described below with reference to Fig. 12. Now, processing performed at the temporal-change information adding unit 94 is described. The temporal-change information adding unit 94 is configured to process population information among each of the feature-group information Ia to Ic (combined, rearranged, and/or the like) in view of temporal changes to generate a third unit of processing of feature-group information.

[0082]

Fig. 12 shows various specific examples of the approach for processing population data in view of temporal changes. It is noted that Fig. 10 described above represents examples based on cell images captured at three different timings while Fig. 12 in this case represents examples based on cell images Ga, Gb, Gc, and Gd at four different timings (24h, 48h, 72h, and 96h, respectively). However, the idea of each processing approach shown in Fig. 12 can also be applied to the examples in Fig. 10 in a similar way.

[0083]

In the example of Fig. 12, first, a standardized

Figs. 20A and 20B show two examples of the approach of generating a predetermined analytical model using the aforementioned sample data sets Iga to Igj shown in Fig. 19. Specifically, the examples in Figs. 20A and 20B correspond to a case where an analytical model for categorizing cell types into type A and type B is generated as discussed in the above examples.

[0103]

Fig. 20A shows an example in which an analytical model is generated by machine learning. In the example of Fig. 20A, an analytical-model generating unit 44 is configured to generate or renew a function (in the example of the figure, $Y = aX + bX + cX$) by performing machine learning using the plurality of sample data sets Iga to Igj, the function taking a value X of each of the M number of parameters in a sample data set as an input parameter, and outputting a score Y.

[0104]

Here, it is assumed that feature-group information is generated from a cell image including an unknown type of cells as imaging subjects, and stored in the feature-group information DB 61 (Fig. 2). The evaluation-target information acquiring unit 46 acquires data having the same form as the sample data sets Iga to Igj (having the same M number of parameters) from the above feature-group information as evaluation-target information from the feature-group information DB 61.

perform classification of the plurality of sample data sets Iga to Igj according to a predetermined algorithm. The types and numbers of classes resulted from classification depend on the plurality of sample data sets Iga to Igj and/or the predetermined algorithm, but here it is assumed that classification into three classes CA, CB, and CN is performed.

[0108]

Here, it is also assumed that feature-group information is generated from a cell image including an unknown type of cells as imaging subjects, and stored in the feature-group information DB 61 (Fig. 2) as in the aforementioned example of Fig. 20A. The evaluation-target information acquiring unit 46 acquires data having the same form as the sample data sets Iga to Igj (having the same M number of parameters) from the above feature-group information as evaluation-target information from the feature-group information DB 61.

[0109]

In this case, the analysis unit 47 classifies the above evaluation-target information into one of three classes CA, CB, and CN. When the above evaluation-target information is classified into the class CA, a cell corresponding to the above evaluation-target information is analyzed to be likely of the type A. When the above evaluation-target information is classified into the class CB, a cell corresponding to the above evaluation-target information is analyzed to be likely of the type B. Alternatively, when the above evaluation-target

sample data set or evaluation-target information.

[0112]

Evaluation-target information qa is included within regions based on the sample data sets of all of the type A cells. Therefore, this means that a cell corresponding to the above evaluation-target information qa is analyzed to be very much likely of the type A. Evaluation-target information qb is included within regions based on the sample data sets of many of the type A cells. Therefore, this means that a cell corresponding to the above evaluation-target information qb is analyzed to be likely of the type A (however, less likely as compared to the evaluation-target information qa).

[0113]

Evaluation-target information qc is included within regions based on the sample data sets of all of the type B cells. Therefore, this means that a cell corresponding to the above evaluation-target information qc is analyzed to be very much likely of the type B. Evaluation-target information qd is included within regions based on the sample data sets of many of the type B cells. Therefore, this means that a cell corresponding to the above evaluation-target information qd is analyzed to be likely of the type B (however, less likely as compared to the evaluation-target information qc).

[0114]

Further, evaluation-target information qe is included in the overlapped region between the regions based on the sample

information. For example, it is assumed that a cell is conclusively determined as the type A merely based on a slightly higher likelihood when there is a possibility of either the type A or the type B as described above. In this case, the analysis result provided is wrong if the cell actually turns out to be of type B. This may be responsible for a future problem which may occur to the user. In contrast, a user is provided with a possibility of either the type A or the type B in the present embodiment. This allows the user to also consider the possibility of type B, enabling the user to easily manage a case where the cell actually turns out to be of type B.

[0140]

As yet another characteristic point, not only an "evaluated probability" of types (cell type) but also a "homology score" are provided. That is, an analysis approach of categorizing cell types is mainly described above for the purpose of explanation, but the similarity in terms of "origins" can also be outputted by analyzing and comparing a sample data set with evaluation-target information in a similar fashion. The above similarity in terms of "origins" is a homology score. For example, when comparing sample data sets which are second and third in the rank, the evaluated probability (the similarity in terms of types) of the sample data set ranked in the second place is "78" while that of the sample data set ranked in the third place is "75." They are

A cell-analyzing information generating apparatus, including: a feature-group information generating means configured to generate, as feature-group information, information including values of N types of feature parameters (wherein N represents an integer having a value of 1 or more) about a morphological feature of a single cell of a plurality of cells or a morphological feature of a cell population based on data of one or more cell images included in a unit, the one or more cell images in the unit being selected from cell images capturing the cell population including the cells in accordance with a predetermined requirement; and an information acquiring means configured to acquire, as analyzing information for use in performing predetermined cell analysis, information including values of M types (wherein M is an integer having a value independent of N) of parameters based on at least one of the N types of feature parameters included in the feature-group information.

[0156]

[Supplemental Note 12]

The cell-analyzing information generating apparatus according to the Supplemental Note 11, wherein the N types of feature parameters includes one or more feature parameters of the cell population in terms of a predetermined point of view, and the information acquiring means is configured to acquire the analyzing information based on one or more feature parameters including at least the one or more feature

CLAIMS

1. A cell-analyzing information generating apparatus, comprising: a feature-group information generating means configured to generate, as feature-group information, information including values of N types of feature parameters (wherein N represents an integer having a value of 1 or more) about a morphological feature of a single cell of a plurality of cells or a morphological feature of a cell population based on data of one or more cell images included in a unit, the one or more cell images in the unit being selected from cell images capturing the cell population including the cells in accordance with a predetermined requirement; and

an information acquiring means configured to acquire, as analyzing information for use in conducting predetermined analysis about the cell to be subjected to analytical evaluation, information including values of M types (wherein M is an integer having a value independent of N) of parameters that are altered according to a feature of the cell to be subjected to analytical evaluation or a feature of the predetermined analysis based on at least one of the N types of feature parameters included in the feature-group information, and

an analysis means configured to perform the predetermined analysis about the cell to be subjected to the analytical evaluation by comparing information about the cell to be subjected to analytical evaluation and the analyzing

information.

2. The cell-analyzing information generating apparatus according to claim 1, wherein the N types of feature parameters include one or more feature parameters of the cell population in terms of a predetermined point of view, and

the information acquiring means is configured to acquire the analyzing information based on one or more feature parameters including at least the one or more feature parameters of the cell population in terms of the predetermined point of view.

3. The cell-analyzing information generating apparatus according to claim 1 or 2, wherein at least one of the one or more cell images in the unit from which the feature-group information is generated is captured at a different timing, and

the analyzing information includes time information capable of specifying a timing of capturing the one or more cell images as one of the values of the M types of parameters.

4. A method of generating cell-analyzing information which can be performed with a cell-analyzing information generating apparatus configured to generate information for use in performing predetermined cell analysis, the method comprising:

a feature-group information generating step of generating,

as feature-group information, information including values of N types of feature parameters (wherein N represents an integer having a value of 1 or more) about a morphological feature of a single cell of a plurality of cells or a morphological feature of a cell population based on data of one or more cell images included in a unit, the one or more cell images in the unit being selected from cell images capturing the cell population including the cells as an imaging subject in accordance with a predetermined requirement; and

an information acquiring step of acquiring, as information for use in performing predetermined analysis about the cell to be subjected to analytical evaluation, information including values of M types (wherein M is an integer having a value independent of N) of parameters that are altered according to a feature of the cell to be subjected to analytical evaluation or a feature of the predetermined analysis based on at least one of the N types of feature parameters included in the feature-group information, and

an analysis step of performing the predetermined analysis about the cell to be subjected to the analytical evaluation by comparing information about the cell to be subjected to analytical evaluation and the analyzing information.

5. A non-transitory computer readable medium storing a program instructing a computer configured to generate information for use in performing predetermined cell analysis to execute control processing, the control processing comprising:

a feature-group information generating step of generating, as feature-group information, information including values of N types of feature parameters (wherein N represents an integer having a value of 1 or more) about a morphological feature of a single cell of a plurality of cells or a morphological feature of a cell population based on data of one or more cell images included in a unit, the one or more cell images in the unit being selected from cell images capturing the cell population including the cells as an imaging subject in accordance with a predetermined requirement; and

an information acquiring step of acquiring, as information for use in performing predetermined analysis about the cell to be subjected to analytical evaluation, information including values of M types (wherein M is an integer having a value independent of N) of parameters that are altered according to a feature of the cell to be subjected to analytical evaluation or a feature of the predetermined analysis based on at least one of the N types of feature parameters included in the feature-group information, and

an analysis step of performing the predetermined analysis about the cell to be subjected to the analytical evaluation by comparing information about the cell to be subjected to analytical evaluation and the analyzing information.