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Data analysis apparatus and data analysis method

Abstract

A data analysis apparatus includes a control unit that performs control of receiving an operation to select analysis data, control of receiving an operation to select a plurality of scripts that execute analysis on the selected analysis data, and control of executing analysis on the selected analysis data by the plurality of selected scripts in parallel. The data analysis apparatus also includes a display unit configured to display analysis results of the analysis data by the control unit on the same screen.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS

(1) The priority application number JP2021-181114, a data analysis apparatus and a data analysis method, Nov. 5, 2021, SAWADA Ryuji, ONO Takeshi, YAMAMOTO Shuhei, TSUSHIMA, Hiroaki, upon which this patent application is based are hereby incorporated by reference.

BACKGROUND OF THE INVENTION

Field of the Invention

(2) The present invention relates to a data analysis apparatus and a data analysis method.

Background Art

(3) Conventionally, a data analysis apparatus and a data analysis method that analyzes image data

using a script are known. Such a data analysis apparatus and a data analysis method are disclosed, for example, in PCT International Publication No. WO2019/180848.

(4) PCT International Publication No. WO2019/180848 discloses a cell image analysis apparatus (data analysis apparatus) for analyzing cell images. Here, a cell image may include a removal target to be removed such as impurities. The cell image analysis apparatus described in PCT International Publication No. WO2019/180848 generates a label image representing a location of a removal target region in the cell image. Then, a set of cell images and label images is used as a data set for machine learning. A plurality of learning models (scripts) for identifying a predetermined removal target generated by the machine learning are registered in the cell image analysis apparatus. Then, processing of one learning model selected by a user from among the plurality of registered learning models is executed.

(5) However, in PCT International Publication No. WO2019/180848, as described above, processing of one learning model (script) selected by the user from among the plurality of registered learning models is executed. In this case, when it is desired to acquire respective analysis results of the plurality of learning models, it is necessary to individually execute processing for each of the plurality of learning models. For this reason, it is considered that the labor of the user increases by the number of learning models (scripts) to be executed. Therefore, there is a demand for a data analysis apparatus and a data analysis method that can reduce the labor of the user when executing a plurality of scripts in parallel.

SUMMARY OF THE INVENTION

(6) The present invention has been made to solve the above problems, and one object of the present invention is to provide a data analysis apparatus and a data analysis method capable of reducing the labor of the user when executing a plurality of scripts.

(7) In order to achieve the above object, a first aspect of the present invention relates to a data analysis apparatus including a control unit configured to perform control of receiving an operation to select analysis data acquired by an analysis device, control of receiving an operation to select a plurality of scripts that perform analysis on the selected analysis data, and control of executing analysis on the selected analysis data by the plurality of selected scripts in parallel and a display unit configured to display analysis results acquired by analyzing the analysis data by the control unit on the same screen. The script means a simple program executable by a computer. Also, “executing analysis in parallel” means “executing analysis at the same time”.

(8) A second aspect of the present invention relates to a data analysis method including a step of receiving a selection of analysis data acquired by an analysis device, a step of selecting a plurality of scripts that execute analysis on the analysis data, and a step of executing analysis on the selected analysis data by the plurality of selected scripts in parallel.

(9) In the data analysis apparatus of the first aspect, as described above, control is performed to execute analysis on the selected analysis data by the plurality of selected scripts in parallel. As a result, since it is not necessary to individually execute the work of processing for each of the plurality of scripts on one piece of data, it is possible to reduce the labor of the user. Therefore, it is possible to reduce the labor of the user when executing the plurality of scripts. In addition, the work time can be shortened compared to the case of performing the work of individually executing processing for each of the plurality of scripts. Further, the same effect can also be obtained in the data analysis method in the second aspect, which includes a step of executing analysis on the selected analysis data by the plurality of selected scripts in parallel.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

(1) FIG. **1** is a diagram showing a configuration of an image analysis apparatus according to an

embodiment.
(2) FIG. **2** is a diagram showing a setting screen of an analysis recipe according to the embodiment.
(3) FIG. **3** is a diagram showing a screen displaying image data and scripts selected on the setting screen of the analysis recipe according to the embodiment.
(4) FIG. **4**A is a diagram showing an example in which one script is selected in the analysis recipe.
(5) FIG. **4**B is a diagram showing an example of a combination of scripts in the analysis recipe.
(6) FIG. **5** is a flow diagram showing an analysis flow by a control unit according to the embodiment.
(7) FIG. **6** is a diagram showing an example of the analysis recipe according to the embodiment.
(8) FIG. **7** is a diagram showing an example of the analysis recipe according to a first modification example of the embodiment.
(9) FIG. **8** is a diagram showing an example of the analysis recipe according to a second modification example of the embodiment.

DETAILED DESCRIPTION OF THE INVENTION

(10) Hereinafter, embodiments embodying the present invention will be described with reference to the drawings.
(11) A configuration of an image analysis apparatus **100** according to the present embodiment will be described with reference to FIGS. **1** to **6**. The image analysis apparatus **100** is an example of a "data analysis apparatus" in the claims.
(12) Configuration of Image Analysis Apparatus
(13) The image analysis apparatus **100** includes a control unit **10** and a display unit **20**. Further, the image analysis apparatus **100** is provided with a storage unit **30** in which image data and the like acquired by an external image acquisition unit **200** is stored. The storage unit **30** is configured by, for example, a hard disk, a flash memory or the like. The display unit **20** displays analysis results acquired by data analysis by the control unit **10**. The image data and the like acquired by the image acquisition unit **200** may be stored in an external device of the image analysis apparatus **100**, or may be stored in a storage region (for example, a cache memory) of the image analysis apparatus **100** different from the storage unit **30**. Further, the image analysis apparatus **100** itself may be provided with a mechanism for acquiring image data for analysis. In addition, the image acquisition unit **200** is an example of an "analysis device" in the claims.
(14) The control unit **10** is configured to function as an image selection reception means **1**, a script selection reception means **2**, a data analysis means **3**, an analysis recipe generation means **4**, a property registration means **5**, and a script registration means **6**. In the control unit **10**, the functions of the image selection reception means **1**, the script selection reception means **2**, the data analysis means **3**, the analysis recipe generation means **4**, the property registration means **5**, and the script registration means **6** can be realized by software such as a program.
(15) As shown in FIG. **2**, the analysis recipe generation means **4** (control unit **10**) performs control of generating an analysis recipe **300** in which a plurality of analysis steps for performing analysis on image data **410** are combined in series. Specifically, the analysis recipe **300** includes an analysis processing step (Step **1**) in which analysis processing is performed using a trained model and an analysis algorithm, and a finishing processing step (Step **2**) in which finishing processing, which will be described later, is performed. That is, the script described later includes a trained model generated by machine learning for analysis of the image data **410**, an analysis algorithm used for performing analysis on the image data **410**, and processing algorithms (a first processing algorithm and a second processing algorithm) used for finishing processing described later. When a trained model capable of excluding images inappropriate for analysis is selected, it is possible to perform a more appropriate analysis by the analysis algorithm. The analysis recipe **300** generated by the analysis recipe generation means **4** (control unit **10**) is stored (registered) in the storage unit **30**. Also, the analysis recipe **300** and the image data **410** are examples of an "analysis flow" and "analysis data" in the claims, respectively. A specific method for generating the analysis recipe **300**

will be described below.
(16) The image selection reception means **1** (control unit **10**) performs control of receiving an operation to select the image data **410** to be analysis targets. Specifically, as shown in FIG. **2**, on the setting screen of the analysis recipe **300**, when the button **311***a* displayed as "Select image" in the upper column **311** in the "Test image" column **310** is selected, a window is displayed in which the image data **410** which are analysis targets can be selected from a plurality of image data stored in the storage unit **30**. Further, when the button **311***b* displayed as "Register image" in the upper column **311** is selected, a window is displayed in which image data not stored in the storage unit **30** (for example, stored in a local PC) can be selected (registered) as image data **410** which are analysis targets. The image data **410** for which the selection has been received is displayed in the lower column **312** in the "Test image" column. In the example shown in FIG. **3**, image data **410** displaying cells **400** are displayed in the lower column **312**.
(17) Further, when the button **311***b* displayed as "Image registration" is selected and the selection of the image data **410** is received, the input of the accompanying information of the image data **410** is received. Then, the selected image data **410** and the input accompanying information are associated with each other and stored (registered) in the storage unit **30**. As an example of registration of the image data **410**, registration of image data of cell culture well will be described. In this case, for example, it may be possible to input the passage number of cells (an operation of removing the medium from the culture system and transferring cells to a new medium) and the culture days of cells as accompanying information.
(18) Further, the control unit **10** performs control of grouping a plurality of image data **410** by conditions, based on the accompanying information. For example, the control unit **10** performs control of dividing the plurality of image data **410** which are analysis targets into a group of data having the same passage number of cells, a group of data having the same culture days of cells, a group of data having both of the same passage number of cells and the same culture days of cells, and the like.
(19) The script selection reception means **2** (control unit **10**) performs control of receiving an operation to select the plurality of scripts that execute analysis on the selected image data **410**. For example, on the setting screen of the analysis recipe **300**, when the button **321***a* displayed as "+ Add script" in the upper column **321** in the "Analysis processing" column **320** is selected, a window is displayed in which scripts to be executed can be selected from the plurality of scripts stored in the storage unit **30**. At this time, scripts to be executed can be selected from the trained models and analysis algorithms registered in the storage unit **30**. The control unit **10** performs analysis on the image data **410** using the selected scripts. Then, analysis results of the selected scripts are displayed in the lower column **322** in the "Analysis processing" column.
(20) Here, in the present embodiment, the script selection reception means **2** (control unit **10**) performs control of executing analysis on the selected image data **410** by the plurality of selected scripts in parallel. Specifically, the script selection reception means **2** (control unit **10**) is configured to perform control of executing analysis on the selected image data **410** by a plurality of selected trained models in parallel, and of executing analysis on the selected image data **410** by a plurality of selected analysis algorithms in parallel. Specifically, when script A and script B are selected in the window displayed by selecting the button **321***a*, the selection of both script A and script B is received. In this case, the data analysis means **3** (control unit **10**) executes analysis using the script A and the script B in parallel. Although FIG. **3** shows an example in which two scripts (script A and script B) are selected, only one script or three or more scripts may be selected.
(21) Specifically, in the analysis recipe **301** shown as an example in FIG. **4**A, only the script A is selected. Further, in the analysis recipe **302** shown as an example in FIG. **4**B, scripts A**1** to A**4** and script B are combined in parallel, and scripts A**1** to A**4** are combined in series with each other.
(22) Further, in the present embodiment, the control unit is configured to perform control of displaying respective analysis results of the selected two or more scripts on the same screen of the

display unit **20**. Specifically, respective analysis results (data **420** and data **430**) of script A and script B selected in the analysis processing step (Step **1**) are displayed in parallel in the lower column **322** in the "Analysis processing" column. Further, the analysis results (data **450** and data **460**) selected in the finishing processing step (Step **2**), which will be described later, are also displayed on the same screen as the analysis results of the selected scripts in the analysis processing step. That is, all analysis results of scripts included in the analysis recipe **300** are displayed on the same screen. FIG. **3** shows, as an example of the data **420**, an analysis result of a binarization processing algorithm for distinguishing cells **400** from the background. FIG. **3** also shows, as an example of the data **430**, an analysis result of an analysis algorithm for color-coding the cells **400** according to the differences in the characteristics (for example, particle size, area, or the like) of the cells **400**.

(23) The control unit **10** is configured to execute another analysis algorithm which is combined in series with one analysis algorithm using the analysis result obtained by executing one analysis algorithm as input data. Specifically, by selecting the button **322***a* displayed as "+ Add script" in the lower column **322**, one or more other scripts that are combined in series with the script A, and perform predetermined analysis using the analysis result of the script A as input data can be selected. Similarly, by selecting the button **322***b* displayed as "+ Add script" in the lower column **322**, one or more other scripts that are combined in series with the script B, and perform predetermined analysis using the analysis result of the script B as input data can be selected.

(24) In addition, in the present embodiment, the script selection reception means **2** (control unit **10**) is configured to execute analysis on the selected image data **410** by the plurality of selected scripts in parallel in each of the plurality of analysis steps of the analysis recipe **300**. That is, the script selection reception means **2** (control unit **10**) performs control of receiving the selection of the plurality of scripts that can be executed in parallel not only in the analysis processing step (Step **1**) but also in the finishing processing step (Step **2**) described later.

(25) Further, the script registration means **6** (control unit **10**) performs control of adding (registering) scripts to the image analysis apparatus **100** based on the user's operation.

(26) Also, the property registration means **5** (control unit **10**) (refer to FIG. **1**) performs control of registering properties including an input and output type, a use, and an extension to each of the scripts. Specifically, the property registration means **5** (control unit **10**) performs the registration of the properties of the scripts based on the user's operation when the scripts are registered in the image analysis apparatus **100** (storage unit **30**) by the script registration means **6** (control unit **10**) (at the time of plug-in). The input and output type includes, for example, information about the dimensions of the input and output data of the script. The use includes, for example, information as to whether the input and output data of the script is image data or table data. The extension includes information about the file format of the input and output data of the script (for example, csv, jpg, txt, and the like).

(27) Also, the property registration means **5** (control unit **10**) (refer to FIG. **1**) performs control of registering properties including an input and output type, a use, and an extension to each of the scripts. Specifically, the property registration means **5** (control unit **10**) performs the registration of the properties of the scripts when the scripts are registered in the image analysis apparatus **100** (storage unit **30**) (at the time of plug-in). The input and output type includes, for example, information about the dimensions of the input and output data of the script. The use includes, for example, information as to whether the input and output data of the script is image data or table data. The extension includes information about the file format of the input and output data of the script (for example, csv, jpg, txt, and the like).

(28) Here, in the present embodiment, the control unit **10** is configured to execute a subsequent script of two scripts combined in series when the properties of the subsequent script match the properties of a preceding script of two scripts. For example, when it is assumed that the type of the output data of the script A is two-dimensional data, the subsequent script is executed when the type

of the input data of the subsequent script combined in series with the script A is the two-dimensional data. Further, the control may be performed based on the use or the extension instead of the input and output data type, or the control may be performed based on two or more of the input and output type, the use, and the extension. When the properties of the preceding script and the subsequent script do not match, a warning may be issued when the subsequent script is executed.

(29) Further, in the present embodiment, the control unit **10** is configured to execute a script having properties that match the properties of the preceding script among one or more selected subsequent scripts. For example, when only one of two scripts which are combined in series with the script A and are executed in parallel has the properties that match the properties of the script A, the only one script is executed and other scripts are not executed.

(30) Further, the above-described properties are registered in the image data **410** whose selection is received by the image selection reception means **1** (control unit **10**). The script that receives the image data **410** whose selection has been received by the image selection reception means **1** as input data is executed when the properties of the script match those of the image data **410**.

(31) Further, each of the plurality of scripts includes information regarding whether the analysis results (output data) are targets of the finishing processing which will be described later. The data **440** that are targets of the finishing processing among the respective analysis results of the scripts in the analysis processing step are temporarily stored (buffered) as targets for the finishing processing and displayed in the column **330**. In FIG. **3**, the data **440** is shown as a void image for simplification.

(32) In the present embodiment, the script includes a first processing algorithm for executing processing of combining at least two or more analysis results among the respective analysis results of the plurality of scripts selected by the script selection reception means **2** (control unit **10**). Specifically, a plurality of analysis results temporarily stored (buffered) as targets for the finishing processing are combined by executing the first processing algorithm.

(33) In the present embodiment, the script includes a second processing algorithm for executing processing of analyzing a variation in two or more analysis results. Specifically, by executing the second processing algorithm, a variation in the plurality of analysis results temporarily stored (buffered) as targets for finishing processing is analyzed.

(34) Further, in the present embodiment, the control unit is configured to be able to execute the first processing algorithm and the second processing algorithm in parallel, and to receive selection one or more of the first processing algorithm and the second processing algorithm. Specifically, on the setting screen of the analysis recipe **300**, when the button **341***a* displayed as "+ Add script" in the upper column **341** in the "Finishing processing" column **340** is selected, a window is displayed in which the first processing algorithm and the second processing algorithm stored in the storage unit **30** can be selected. For example, when both the first processing algorithm and the second processing algorithm are selected, the first processing algorithm and the second processing algorithm are executed in parallel, and the analysis results (data **450** and data **460**) corresponding to each of the first processing algorithm and the second processing algorithm are displayed in the lower column **342** in the "Finishing processing" column. It is also possible to select only one of the first processing algorithm and the second processing algorithm. In FIG. **3**, each of the data **450** and the data **460** is shown as a void image for simplification.

(35) Analysis Flow

(36) Next, an analysis flow by the control unit **10** of the image analysis apparatus **100** will be described with reference to FIG. **5**.

(37) First, as shown in FIG. **5**, in step **101**, a selection operation of the image data **410** by the user is received. Specifically, on the setting screen of the analysis recipe **300** shown in FIGS. **2** and **3**, the button **311***a* displayed as "Select image" or the button **311***b* displayed as "Register image" is selected, whereby the image data **410** to be targets of the analysis processing can be selected.

(38) Next, in step **102**, the selected image data **410** are grouped by conditions. Specifically, the control unit **10** performs control of dividing the plurality of image data **410** selected in step **101** into a plurality of groups by conditions such as the passage number of the cells, the culture days of the cells, and the like. Each of the plurality of groups includes one or more pieces of image data.
(39) Next, in step **103**, the control unit **10** performs control of listing one group of image data **410** for which the analysis processing has not yet been performed among the plurality of groups grouped in step **102**.
(40) Next, in step **104**, the control unit **10** performs control of reading one piece of image data among the unanalyzed image data **410** listed in step **103**.
(41) Next, in step **105**, the data analysis means **3** (control unit **10**) performs control of executing processing according to the analysis recipe **300** for the one piece of image data **410** read in step **104**. An example of the analysis recipe **300** is described later with reference to FIG. **6**. In step **105**, only the analysis processing step (Step **1**, refer to FIG. **3**) of the analysis recipe **300** is performed.
(42) Next, in step **106**, the control unit **10** determines whether the respective analysis results of the plurality of scripts acquired in step **105** are targets of the finishing processing. Each time each of the plurality of scripts in step **105** is executed, the control unit **10** determines whether the analysis results are targets of the finishing processing. In other words, the control unit **10** determines whether the analysis results are targets of the finishing processing while executing the processing according to the analysis recipe **300**. The processing in step **107** is performed for the analysis results determined to be targets of the finishing processing. The processing in step **108** is performed for the analysis results determined not to be targets of the finishing processing. After all of the plurality of scripts in the analysis recipe **300** have been executed, it may be determined whether all the respective analysis results are targets of the finishing processing.
(43) In step **107**, the analysis results determined to be targets of the finishing processing in step **106** are temporarily buffered in a cache memory or the like. In step **108**, the analysis results determined not to be targets of the finishing processing in step **106** are stored (registered) in the storage unit **30**.
(44) Next, in step **109**, it is determined whether the processing according to the analysis recipe **300** for all the image data **410** listed in step **103** has been completed. When it is determined that the processing according to the analysis recipe **300** for all the listed image data **410** has been completed, the process proceeds to step **110**. When it is determined that the processing according to the analysis recipe **300** for all the listed image data **410** has not been completed, the process returns to step **104**.
(45) Next, in step **110**, it is determined whether the processing according to the analysis recipe **300** for all the groups grouped by conditions in step **102** has been completed. When it is determined that the processing according to the analysis recipe **300** for all groups has been completed, the process proceeds to step **111**. When it is determined that the processing according to the analysis recipe **300** for all groups has not been completed, the process returns to step **103**.
(46) Next, in step **111**, the finishing processing is performed on the data designated for the finishing processing (buffered in step **107**). That is, the finishing processing step (Step **2**, refer to FIG. **3**) in the analysis recipe **300** is performed. An example of the finishing processing (first processing algorithm and second processing algorithm) will be described later.
(47) In step **112**, the analysis results of the finishing processing acquired in step **111** are stored (registered) in the storage unit **30**.
(48) Analysis Recipe
(49) Next, an example of the analysis recipe **300** will be described with reference to FIG. **6**. Step **1051** to step **1057** in FIG. **6** are steps included in step **105** in FIG. **5**. Step **1111** and step **1112** in FIG. **6** are steps included in step **111** in FIG. **5**.
(50) First, as shown in FIG. **6**, the control unit **10** applies a trained model that has trained the features of an in-focus image and an out-of-focus image to input image data **410**. As a result, the control unit **10** performs control of displaying an image of the cells **400** that are in-focus in the

input image data **410** and an image of the cells **400** that are out-of-focus in the input image data **410** by distinguishing them, for example, by color. The image of the cells **400** that are in-focus and the image of the cells **400** that are out-of-focus may be distinguished by a method different from the method described above. Also, image data in which a subject other than the cells **400** is displayed may be used.

(51) Next, in step **1052**, a focus coincidence evaluation algorithm is executed using the analysis result (output data) in step **1051** as input data. As a result, in the input data, the ratio of a region where the cells **400** that are in-focus is displayed out of all the regions where the cells **400** are displayed is calculated.

(52) Next, in step **1053**, the trained model that has trained a cell region and a background region is applied using the analysis result (output data) in step **1052** as input data. As a result, the cell region and the background region are distinguished in the input data.

(53) Next, in step **1054**, a binarization processing algorithm is applied using the analysis result (output data) in step **1053** as input data. As a result, data in which the value of the cell region and the value of the background region in the input data are set to 1 and 0, respectively, is acquired.

(54) Next, a particle size analysis algorithm and an area ratio analysis algorithm are selected as analysis algorithms using the analysis result (output data) in step **1054** as input data. As a result, in step **1055** and step **1056**, a particle size analysis algorithm (step **1055**) and an area ratio analysis algorithm of the cells **400** (step **1056**) are executed in parallel using the analysis result (output data) in step **1054** as input data. The particle size of the cell **400** displayed in the input data is calculated by executing the particle size analysis algorithm in step **1055**. The area ratio of the cells **400** displayed in the input data (for example, the area ratio occupied by each of the cells **400** to the total area of the region where the cells **400** are displayed) is calculated by executing the area ratio analysis algorithm of the cells **400** in step **1056**.

(55) Next, in step **1057**, a frequency distribution graph creation algorithm is executed using the analysis result (output data) in step **1055** as input data. As a result, a graph showing the number of cells **400** by particle sizes is created.

(56) Next, in step **1111**, the analysis result (output data) in step **1056** and the analysis result (output data) in step **1057** are used as input data to execute the first processing algorithm for creating a graph. Specifically, when it is assumed that a predetermined graph is created by the processing in step **1056**, the graph acquired by the processing in step **1056** and the graph acquired by the processing in step **1057** are integrated with each other by executing the first processing algorithm (combined into one graph). Graphs that correspond to different conditions from each other or graphs of image data **410** different from each other may be integrated by executing the first processing algorithm.

(57) Further, in step **1112**, a variation in data that correspond to different conditions or a variation in data of image data **410** different from each other are analyzed by executing the second processing algorithm. The processing contents in step **1111** and step **1112** are examples, and the present disclosure is not limited thereto.

(58) The analysis processing in step **1111** and the analysis processing in step **1112** are executed in parallel.

Effect of Present Embodiment

(59) The image analysis apparatus **100** of the present embodiment can obtain the following effects.

(60) In the present embodiment, as described above, the image analysis apparatus **100** includes the control unit **10** that performs control of executing analysis on the selected image data **410** by the plurality of selected scripts in parallel. As a result, since it is not necessary to individually execute the work of processing for each of the plurality of scripts on one piece of data, it is possible to reduce the labor of the user. Therefore, it is possible to reduce the labor of the user when executing the plurality of scripts. In addition, the work time can be shortened compared to the case of performing the work of individually executing processing for each of the plurality of scripts. The

user can compare the respective analysis results of the plurality of selected scripts on the same screen by displaying the respective analysis results of the plurality of selected scripts on the same screen.

(61) In the present embodiment, further effects can be obtained the following configuration.

(62) In the present embodiment, as described above, the control unit **10** is configured to perform control of generating an analysis recipe **300** in which a plurality of analysis steps for analyzing image data **410** are combined in series, and to execute analysis on selected image data **410** by the plurality of selected scripts in parallel in each of the plurality of analysis steps of the generated analysis recipe **300**. As a result, since the scripts can be executed in parallel in each of the plurality of analysis steps, the labor of the user can be further reduced.

(63) In addition, in the present embodiment, as described above, the script includes a trained model generated by machine learning for analysis of the image data **410** and an analysis algorithm used to execute analysis on the image data **410**. In addition, the control unit **10** is configured to execute analysis on the selected image data **410** by a plurality of selected trained models in parallel, and to execute analysis on the selected image data **410** by a plurality of selected analysis algorithms in parallel. As a result, since the plurality of trained models can be executed in parallel and the plurality of analysis algorithms can be executed in parallel, the labor of the user can be reduced in each of the analysis using the trained models and the analysis using the analysis algorithms.

(64) In the present embodiment, as described above, the control unit **10** is configured to execute another analysis algorithm which is combined in series with one analysis algorithm, using the analysis result obtained by executing one analysis algorithm as input data. As a result, the analysis recipe **300** can be easily extended by combining the analysis algorithms in series. Also, unlike the case where one algorithm and another algorithm are described as one script, one algorithm and another algorithm can be used individually. As a result, each of a variation in the analysis recipe **300** and a variation in processing modules consisting of the plurality of algorithms can be easily increased.

(65) Also, unlike the case where one algorithm and another algorithm are described as one script, the respective analysis results of one algorithm and another algorithm can be individually acquired and confirmed by making one algorithm and another algorithm into separate scripts. As a result, each algorithm can be individually modified when unintended analysis results are obtained. Furthermore, it is possible to easily analyze a variation in data based on the analysis results for each of algorithms, and to easily perform processing of combining each of data.

(66) In addition, since an amount of description of the script is reduced as compared with the case where one algorithm and another algorithm are described as one script, it is possible to reduce the possibility that the configuration of the script is partially similar to the configurations of other scripts. As a result, since it is possible to reduce the possibility that other similar scripts are retrieved, it is possible to facilitate the retrieval of scripts.

(67) In the present embodiment, as described above, the control unit **10** performs control of registering properties including the input and output type, the use, and the extension for each of the scripts, and is configured to execute a subsequent script of two scripts combined in series when the properties of the subsequent script match the properties of a preceding script of two scripts. As a result, since it is possible to prevent the execution of the subsequent script having properties different from those of the preceding script, it is possible to suppress the generation of analysis results in which inconsistency occurs by the subsequent script. Since the user can select the subsequent script based on the properties of the preceding script, the subsequent script can be easily selected.

(68) In the present embodiment, as described above, the control unit **10** is configured to execute a script having properties that match the properties of the preceding script among one or more selected subsequent scripts. As a result, since one or more selected subsequent scripts that do not match the properties of the preceding script are not executed, it is possible to prevent an increase in

a control load of the control unit **10** due to execution of a script that does not match the properties of the preceding script.

(69) Further, in the present embodiment, as described above, the script includes a first processing algorithm for executing processing of combining at least two or more analysis results among the respective analysis results of the plurality of selected scripts. As a result, one analysis result can be generated based on two or more analysis results by the first processing algorithm. As a result, the user can easily grasp the correlation of two or more analysis results based on the one analysis result that has been combined.

(70) In the present embodiment, as described above, the script further includes a second processing algorithm for executing processing of analyzing a variation in two or more analysis results. As a result, the user can easily grasp the correlation of two or more analysis results based on the processing results of the second processing algorithm.

(71) In the present embodiment, as described above, the control unit **10** is configured to execute the first processing algorithm and the second processing algorithm in parallel. As a result, since the first processing algorithm and the second processing algorithm can be executed in parallel, the labor of the user can be reduced as compared with the case where the processing of combining two or more analysis results and the analysis of a variation in two or more analysis results are individually performed.

(72) In the present embodiment, as described above, the data analysis method includes a step of executing analysis on the selected image data **410** by the plurality of selected scripts in parallel. As a result, the plurality of scripts can be executed on one piece of data in parallel. As a result, since it is not necessary to individually execute the work of processing for each of the plurality of scripts on one piece of data, it is possible to provide an image analysis method that can reduce the labor of the user.

Modification Example

(73) It needs to consider that the embodiments disclosed herein are examples in all respects and are not considered to be restrictive. The scope of the present invention is shown by the claims, not the description of the above embodiment, and further includes all changes (modification examples) within the meaning and the scope equivalent to the scope of claims.

(74) For example, in the above-described embodiment, an example of the analysis recipe **300** in which the plurality of scripts are combined in series and in parallel is shown, but the present invention is not limited thereto. For example, an analysis recipe **500** (refer to FIG. **7**) in which the plurality of scripts are combined only in series may be generated, or an analysis recipe **600** (refer to FIG. **8**) in which the plurality of scripts are combined only in parallel may be generated.

(75) In the present embodiment, as described above, an example in which analysis algorithms are combined in series and in parallel is shown, but the present invention is not limited thereto. Analysis modules consisting of the plurality of analysis algorithms may be combined in series and in parallel, or the analysis modules and the analysis algorithms (trained models) may be combined in series and in parallel.

(76) In the above-described embodiment, an example in which the analysis recipe **300** includes both a trained model and an analysis algorithm is shown, but the present invention is not limited thereto. For example, the analysis recipe may not include either the trained model or the analysis algorithm. Also, the analysis recipe may not include the finishing processing.

(77) In the above-described embodiment, an example in which an analysis processing step is provided that can select both a trained model and an analysis algorithm is shown, but the present invention is not limited thereto. A step in which only the trained model can be selected and a step in which only the analysis algorithm can be selected may be combined in series with each other.

(78) In the above-described embodiment, an example in which the script includes a first processing algorithm and a second processing algorithm as algorithms for finishing processing, but the present invention is not limited thereto. The script may include a processing algorithm for executing

processing on two or more processing results other than the first processing algorithm and the second processing algorithm as an algorithm for finishing processing.

(79) In the above-described embodiment, the image analysis apparatus **100** that analyzes the image data **410** is shown as an example of the data analysis apparatus, but the present invention is not limited thereto. The data analysis apparatus may be an analysis apparatus that analyzes analysis data other than image data (for example, analysis results of gas chromatography, and the like).

(80) Item 1

(81) A data analysis apparatus including: a control unit configured to perform control of receiving an operation to select analysis data acquired by an analysis device, control of receiving an operation to select a plurality of scripts that execute analysis on the selected analysis data, and control of executing analysis on the selected analysis data by the plurality of selected scripts in parallel; and a display unit configured to display analysis results acquired by analyzing the analysis data by the control unit on the same screen.

Item 2

(82) The data analysis apparatus according to Item 1, in which the control unit is configured to perform control of generating an analysis flow in which a plurality of analysis steps for executing analysis on the analysis data are combined in series, and to execute analysis on the selected analysis data by the plurality of selected scripts in parallel in each of the plurality of analysis steps in the generated analysis flow.

(83) Item 3

(84) The data analysis apparatus according to Item 1 or 2, in which the script includes a trained model generated by machine learning for analyzing the analysis data, and an analysis algorithm used for executing analysis on the analysis data, and the control unit is configured to execute analysis on the selected analysis data by a plurality of selected trained models in parallel, and to execute analysis on the selected analysis data by a plurality of selected analysis algorithms in parallel.

Item 4

(85) The data analysis apparatus according to any one of Items 1 to 3, in which the script includes a trained model generated by machine learning for analyzing the analysis data, and an analysis algorithm used for executing analysis on the analysis data, and the control unit is configured to execute another analysis algorithm combined in series with one analysis algorithm by using the analysis result obtained by executing the one analysis algorithm as input data.

Item 5

(86) The data analysis apparatus according to any one of Items 1 to 4, in which the control unit is configured to perform control of registering properties including an input and output type, a use, and an extension to each of the scripts, and to execute a subsequent script of two scripts combined in series when the properties of the subsequent script match the properties of a preceding script of two scripts.

(87) Item 6

(88) The data analysis apparatus according to Item 5, in which the control unit is configured to execute the script having properties that match the properties of the preceding script among one or more selected subsequent scripts.

(89) Item 7

(90) The data analysis apparatus according to any one of Items 1 to 6, in which the script includes a first processing algorithm for executing processing of combining at least two or more analysis results among the respective analysis results of the plurality of selected scripts.

(91) Item 8

(92) The data analysis apparatus according to Item 7, in which the script further includes a second processing algorithm for executing processing of analyzing a variation in two or more analysis results.

(93) Item 9
(94) The data analysis apparatus according to Item 8, in which the control unit is configured to execute the first processing algorithm and the second processing algorithm in parallel.
(95) Item 10
(96) A data analysis method including: a step of receiving a selection of analysis data acquired by an analysis device; a step of selecting a plurality of scripts that execute analysis on the analysis data; and a step of executing analysis on the selected analysis data by the plurality of selected scripts in parallel.

Claims

1. A data analysis apparatus comprising: a control unit configured to: receive an operation to select analysis data acquired by an analysis device, receive an operation to select a plurality of machine learning models that execute analysis on the selected analysis data, and execute analysis on the selected analysis data by the plurality of selected machine learning models in parallel; and a display unit configured to display analysis results acquired by analyzing the analysis data by the control unit on a same screen, wherein the control unit is further configured to perform a finishing process by a first processing algorithm and a second processing algorithm analyzing the analysis results after performing the analysis in parallel by the plurality of selected machine learning models.
2. The data analysis apparatus according to claim 1, wherein the control unit is configured to generate an analysis flow in which a plurality of analysis steps for executing analysis on the analysis data are combined in series, and to execute analysis on the selected analysis data by the plurality of selected machine learning models in parallel in each of the plurality of analysis steps in the generated analysis flow.
3. The data analysis apparatus according to claim 1, wherein the plurality of machine learning models includes a trained model generated by machine learning for analyzing the analysis data, and an analysis algorithm used for executing analysis on the analysis data, and the control unit is configured to execute analysis on the selected analysis data by a plurality of selected trained models in parallel, and to execute analysis on the selected analysis data by a plurality of selected analysis algorithms in parallel.
4. The data analysis apparatus according to claim 1, wherein the plurality of machine learning models includes a trained model generated by machine learning for analyzing the analysis data, and an analysis algorithm used for executing analysis on the analysis data, and the control unit is configured to execute another analysis algorithm combined in series with one analysis algorithm by using the analysis result obtained by executing the one analysis algorithm as input data.
5. The data analysis apparatus according to claim 1, wherein the control unit is configured to register properties including an input and output type, a use, and an extension to each of the plurality of machine learning models, and to execute a subsequent machine learning model of two machine learning models combined in series when the properties of the subsequent machine learning model match the properties of a preceding machine learning model of two machine learning models.
6. The data analysis apparatus according to claim 5, wherein the control unit is configured to execute the machine learning model having properties that match the properties of the preceding machine learning model among one or more selected subsequent machine learning models.
7. The data analysis apparatus according to claim 1, wherein the plurality of machine learning models includes the first processing algorithm for executing processing of combining at least two or more analysis results among the respective analysis results of the plurality of selected machine learning models.
8. The data analysis apparatus according to claim 7, wherein the plurality of machine learning models further includes the second processing algorithm for executing processing of analyzing a

variation in two or more analysis results.

9. The data analysis apparatus according to claim 8, wherein the control unit is configured to execute the first processing algorithm and the second processing algorithm in parallel.

10. A data analysis method comprising: receiving a selection of analysis data acquired by an analysis device; selecting a plurality of machine learning models that execute analysis on the analysis data; executing analysis on the selected analysis data by the plurality of selected machine learning models in parallel; and performing a finishing process by a first processing algorithm and a second processing algorithm analyzing analysis results after performing the analysis in parallel by the plurality of selected machine learning models.