(12) STANDARD PATENT (11) Application No. **AU 2013224718 B2**
(19) AUSTRALIAN PATENT OFFICE

(54) Title
Graph display control device, graph display control method and storage medium storing graph display control program

(51) International Patent Classification(s)
G06F 3/048 (2006.01)

(21) Application No: **2013224718** (22) Date of Filing: **2013.09.06**

(30) Priority Data

(31) Number	(32) Date	(33) Country
2012-203818	**2012.09.18**	**JP**

(43) Publication Date: **2014.04.03**
(43) Publication Journal Date: **2014.04.03**
(44) Accepted Journal Date: **2016.04.14**

(71) Applicant(s)
CASIO COMPUTER CO., LTD.

(72) Inventor(s)
SUZUKI, Kentaro

(74) Agent / Attorney
Griffith Hack, GPO Box 1285, Melbourne, VIC, 3001

(56) Related Art
FX-570ES User's Guide, CASIO
EP 1505511 A2
WO 2009/099894 A1

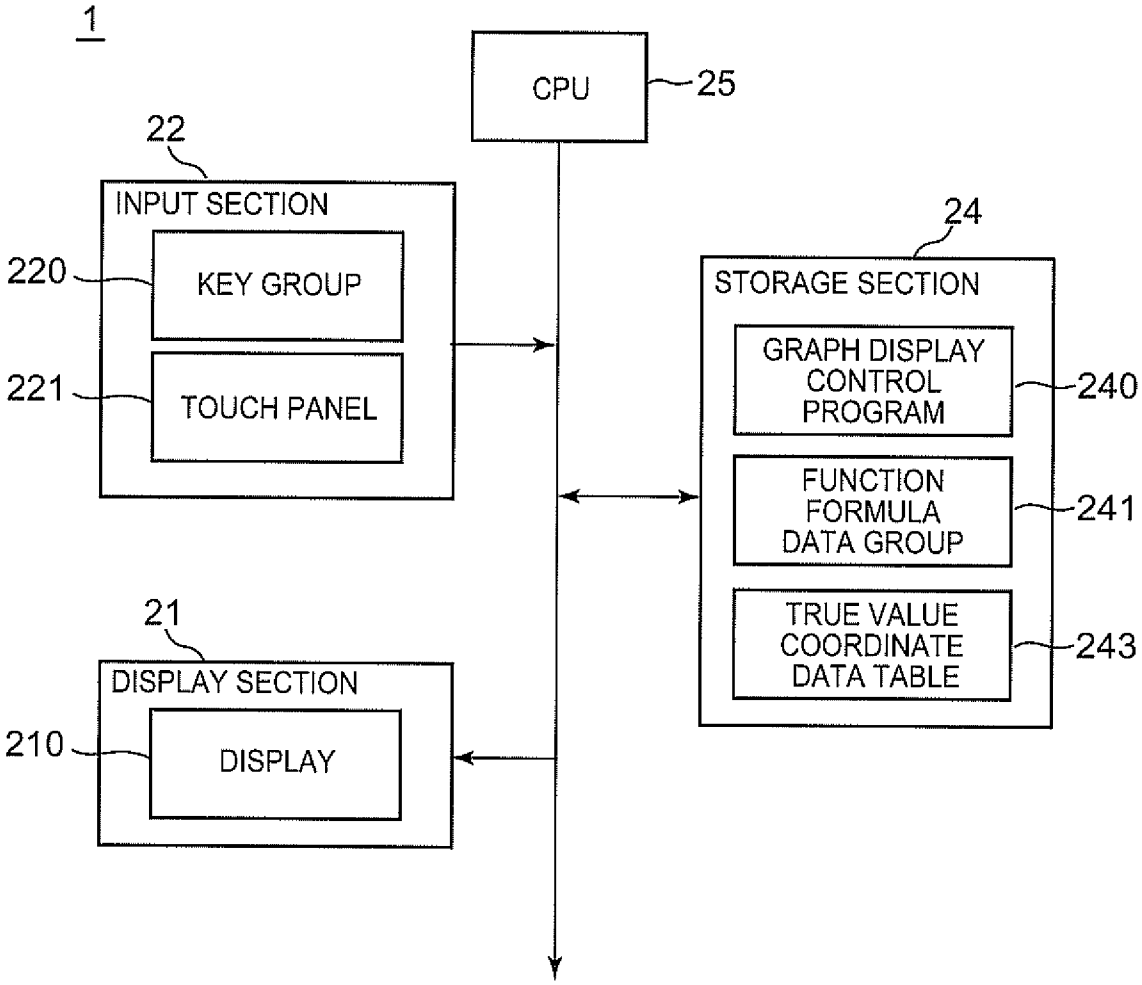
2013224718 06 Sep 2013

ABSTRACT OF THE DISCLOSURE

A graph display control device, a graph display control method, and a storage medium storing a graph display control program are shown. According to one implementation, the graph display control device includes a display unit and other various units. A true value judging unit judges whether it is possible to display at least one of the variables of a coordinate value of the specified point in a true value. A true value coordinate display control unit displays the variable of the coordinate value with a true value when it is judged that it can be displayed with the true value. A coordinate value display control unit displays the variable of the coordinate value as a value within predetermined digits when judged that the coordinate cannot be displayed with the true value.

2013224718 06 Sep 2013

FIG. 1



GRAPH DISPLAY CONTROL DEVICE, GRAPH DISPLAY CONTROL METHOD AND STORAGE MEDIUM STORING GRAPH DISPLAY CONTROL PROGRAM

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a graph display control device, a graph display control method, and a storage medium storing a graph display control program.

2. Description of the Related Art

Conventionally, a graph display device such as a graph scientific calculator includes a tracing function of a graph, and it is possible to move a cursor on a graph to display coordinates of the cursor (for example, see Japanese Patent Application Laid-Open Publication No. H8-179750). The graph display device described in the patent document is able to display a plurality of graphs simultaneously, and it is possible to switch to the graph to be traced.

In a graph showing functions, there is a point (hereinafter referred to as feature point) where coordinates may be represented as true values using "√", "π", and a fraction. It is very important when studying functions to understand such feature points.

However, in a conventional graph display device, when the xy coordinates of the cursor position is displayed on

2013224718 26 Feb 2016

the graph, the value of the y-coordinate is calculated from the x-coordinate of the cursor position, and the x-coordinate and the approximation of the y-coordinate (for example, value of 10 significant figures) are displayed. Therefore, even if it is possible to show the coordinates of the feature point as a true value using "√", "π", and a fraction, the feature point is not shown as a true value. Consequently, there is a problem that learning efficiency decreases.

SUMMARY OF THE INVENTION

The present invention has been made in consideration of the above situation.

According to an aspect of the present invention, there is provided a graph display control device including:

a display unit; and

a processor;

wherein the processor is configured to perform processes including:

setting a coordinate system with a plurality of variables and including coordinate axes in different directions for each variable, and controlling the display unit to display a function graph of the plurality of variables;

controlling to specify an arbitrary point on the

2013224718 26 Feb 2016

function graph as a specified point based on user operation;

increasing or reducing by a predetermined amount a coordinate of a first variable among the plurality of variables of the specified point based on user operation;

calculating a coordinate of a second variable among the coordinates of the plurality of variables on the function graph corresponding with the increased or reduced coordinate of the first variable, and specifying a point of the increased or reduced coordinate of the first variable and the calculated coordinate of the second variable as a specified point after movement;

as judging processing (i), judging whether it is possible to display the coordinates of the specified point after movement in a true value state;

when it is judged that it is not possible to display the coordinates of the specified point after movement in the true value state, as judging processing (ii), judging whether there is a coordinate of the first variable that can be displayed in a true value state between the coordinate of the first variable of the specified arbitrary point on the graph and the coordinate of the first variable of the specified point after movement;

when it is judged that there is a coordinate of the first variable that can be displayed in the true value state between the coordinate of the first variable of the

2013224718 26 Feb 2016

specified arbitrary point on the graph and the coordinate of the first variable of the specified point after movement, specifying the coordinate of the first variable that can be displayed in the true state as a true value first variable coordinate, and calculating a coordinate of a second variable among coordinates of the plurality of variables on the function graph corresponding to the true value first variable coordinate;

as the judging processing (iii), judging whether the coordinate of the second variable corresponding to the calculated true value first variable coordinate can be displayed in a true value state; and

controlling the display unit to display the coordinates of the specified point of the true value first variable coordinate and the coordinate of the second variable corresponding to the true value first variable coordinate.

In an embodiment, the judging processing (i) is processing that judges whether the coordinate of the specified point after movement can be displayed in a true value state using a formula including one or a plurality of a radical root, π, and a fraction;

the judging processing (ii) is processing that judges whether there is the coordinate of the first variable that can be displayed in the true value state using the formula including one or a plurality of a radical root, π, and a fraction between the coordinate of the first variable of

2013224718 26 Feb 2016

the specified arbitrary point on the graph and the coordinate of the first variable of the specified point after movement;

the judging processing (iii) is processing that judges whether the coordinate of the second coordinate corresponding to the calculated true value first variable coordinate can be displayed in the true value state using the formula including one or a plurality of a radical root, π, and a fraction; and

the controlling of the display unit to display in the true value state the coordinates of the specified point of the true value first variable coordinate and the coordinate of the second variable corresponding to the true value first variable coordinate and the coordinate of the second variable corresponding to the true value first variable coordinate in the true value state using the formula including one or a plurality of a radical root, π, and a fraction.

In another embodiment, the processor is configured to perform processes including,

when it is judged in the judging processing (i) that the coordinates of the specified point after movement can be displayed in the true value state, controlling the display unit to display the coordinates of the specified point after movement in the true value state.

The processor may be configured to perform processes

2013224718 26 Feb 2016

including,

registering in a table the true value first variable coordinate and the coordinate of the second variable corresponding to the true value first variable coordinate as true value coordinates.

According to another aspect of the present invention, there is provided a graph display control method of an electronic device including a display unit, the method including:

setting a coordinate system with a plurality of variables and including coordinate axes in different directions for each variable, and controlling the display unit to display a function graph of the plurality of variables;

specifying an arbitrary point on the function graph as a specified point based on user operation;

increasing or reducing by a predetermined amount a coordinate of a first variable among the plurality of variables of the specified point based on user operation;

calculating a coordinate of a second variable among the coordinates of the plurality of variables on the function graph corresponding with the increased or reduced coordinate of the first variable, and specifying a point of the increased or reduced coordinate of the first variable and the calculated coordinate of the second variable as a specified point after movement;

2013224718 26 Feb 2016

as judging processing (i), judging whether it is possible to display the coordinates of the specified point after movement in a true value state;

when it is judged that it is not possible to display the coordinates of the specified point after movement in the true value state, as judging processing (ii), judging whether there is a coordinate of the first variable that can be displayed in a true value state between the coordinate of the first variable of the specified arbitrary point on the graph and the coordinate of the first variable of the specified point after movement;

when it is judged that there is a coordinate of the first variable that can be displayed in the true value state between the coordinate of the first variable of the specified arbitrary point on the graph and the coordinate of the first variable of the specified point after movement, specifying the coordinate of the first variable that can be displayed in the true state as a true value first variable coordinate, and calculating a coordinate of a second variable among coordinates of the plurality of variables on the function graph corresponding to the true value first variable coordinate;

as the judging processing (iii), judging whether the coordinate of the second variable corresponding to the calculated true value first variable coordinate can be displayed in a true value state; and

2013224718 26 Feb 2016

controlling the display unit to display the coordinates of the specified point of the true value first variable coordinate and the coordinate of the second variable corresponding to the true value first variable coordinate.

According to a still further aspect of the present invention, there is provided a computer-readable storage medium having a graph display control program stored thereon for controlling a computer including a display unit and a user operation unit, wherein the program controls the computer to:

set a coordinate system with a plurality of variables and including coordinate axes in different directions for each variable, and control the display unit to display a function graph of the plurality of variables;

specify an arbitrary point on the function graph as a specified point based on user operation;

increase or reduce by a predetermined amount a coordinate of a first variable among the plurality of variables of the specified point based on user operation;

calculate a coordinate of a second variable among the coordinates of the plurality of variables on the function graph corresponding with the increased or reduced coordinate of the first variable, and specify a point of the increased or reduced coordinate of the first variable and the calculated coordinate of the second variable as a

2013224718 26 Feb 2016

specified point after movement;

as judging processing (i), judge whether it is possible to display the coordinates of the specified point after movement in a true value state;

when it is judged that it is not possible to display the coordinates of the specified point after movement in the true value state, as judging processing (ii), judge whether there is a coordinate of the first variable that can be displayed in a true value state between the coordinate of the first variable of the specified arbitrary point on the graph and the coordinate of the first variable of the specified point after movement;

when it is judged that there is a coordinate of the first variable that can be displayed in the true value state between the coordinate of the first variable of the specified arbitrary point on the graph and the coordinate of the first variable of the specified point after movement, specify the coordinate of the first variable that can be displayed in the true state as a true value first variable coordinate, and calculate a coordinate of a second variable among coordinates of the plurality of variables on the function graph corresponding to the true value first variable coordinate;

as the judging processing (iii), judge whether the coordinate of the second variable corresponding to the calculated true value first variable coordinate can be

2013224718 26 Feb 2016

displayed in a true value state; and

control the display unit to display the coordinates of the specified point of the true value first variable coordinate and the coordinate of the second variable corresponding to the true value first variable coordinate.

According to another aspect of the present invention, there is provided a graph display control program for controlling a computer including a display unit and a user operation unit, wherein the program controls the computer to:

set a coordinate system with a plurality of variables and including coordinate axes in different directions for each variable, and control the display unit to display a function graph of the plurality of variables;

specify an arbitrary point on the function graph as a specified point based on user operation;

increase or reduce by a predetermined amount a coordinate of a first variable among the plurality of variables of the specified point based on user operation;

calculate a coordinate of a second variable among the coordinates of the plurality of variables on the function graph corresponding with the increased or reduced coordinate of the first variable, and specify a point of the increased or reduced coordinate of the first variable and the calculated coordinate of the second variable as a specified point after movement;

as judging processing (i), judge whether it is possible to display the coordinates of the specified point after movement in a true value state;

when it is judged that it is not possible to display the coordinates of the specified point after movement in the true value state, as judging processing (ii), judge whether there is a coordinate of the first variable that can be displayed in a true value state between the coordinate of the first variable of the specified arbitrary point on the graph and the coordinate of the first variable of the specified point after movement;

when it is judged that there is a coordinate of the first variable that can be displayed in the true value state between the coordinate of the first variable of the specified arbitrary point on the graph and the coordinate of the first variable of the specified point after movement, specify the coordinate of the first variable that can be displayed in the true state as a true value first variable coordinate, and calculate a coordinate of a second variable among coordinates of the plurality of variables on the function graph corresponding to the true value first variable coordinate;

as the judging processing (iii), judge whether the coordinate of the second variable corresponding to the calculated true value first variable coordinate can be displayed in a true value state; and

control the display unit to display the coordinates of the specified point of the true value first variable coordinate and the coordinate of the second variable corresponding to the true value first variable coordinate.

According to the present invention, it is possible to display coordinates of a point on a graph with a true value.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention and the above-described objects, features and advantages thereof will become more fully understood from the following detailed description with the accompanying drawings and wherein;

FIG. 1 is a block diagram showing a functional configuration of a graph display device;

FIG. 2 is a flowchart showing a flow of graph display control processing;

FIG. 3A is a diagram showing a display content of a display;

FIG. 3B is a diagram showing a display content of a display;

FIG. 3C is a diagram showing a display content of a display;

FIG. 3D is a diagram showing a display content of a display;

FIG. 4A is a diagram showing a display content of a

2013224718 26 Feb 2016

display;

FIG. 4B is a diagram showing a display content of a display;

FIG. 4C is a diagram showing a display content of a display;

FIG. 5A is a diagram showing a display content of a display;

FIG. 5B is a diagram showing a display content of a display;

FIG. 5C is a diagram showing a display content of a display;

FIG. 5D is a diagram showing a display content of a display;

FIG. 6A is a diagram showing a display content of a display;

FIG. 6B is a diagram showing a display content of a display; and

FIG. 6C is a diagram showing a display content of a display.

DETAILED DESCRIPTION OF THE preferred embodiment

An example of an embodiment of the present invention is described in detail with reference to the attached drawings. The scope of the invention is not limited to the illustrated examples.

[Configuration]

FIG. 1 is a block diagram showing a schematic configuration of a graph display device 1 of the present embodiment.

As shown in the drawings, the graph display device 1 of the present embodiment includes a display section 21, an input section 22, a storage section 24, a CPU 25, and the like.

The display section 21 includes a display 210, and various pieces of information are displayed on the display 210 based on display signals input from the CPU 25. The display 210 of the present embodiment is formed as one with a touch panel 221 and is able to receive touching operation by the user.

The input section 22 includes key group 220 and the above described touch panel 221. The input section 22 outputs to the CPU 25 signals corresponding to the type of touched key or the position pressed on the touch panel 221.

The storage section 24 is a memory which stores programs and data to execute various functions of the graph display device 1 and which functions as a work region of the CPU 25. According to the present embodiment, the storage section 24 stores a graph display control program 240, a function formula group 241, a true value coordinate data table 243, and the like, regarding

the present invention.

A graph display control program 240 is a program to allow the CPU 25 to perform a later described graph display control processing (see FIG. 2).

The function formula data group 241 includes a plurality of pieces of function formula data.

In the later described graph display control processing (see FIG. 2), coordinates which can be displayed in a true value state among the coordinates on the graph are accumulated and stored in the true value coordinate data table 243. Here, according to the present embodiment, "coordinates" are a pair of a value of a coordinate in an x-axis direction (hereinafter referred to as x-coordinate), and a value of a coordinate in a y-axis direction (hereinafter referred to as y-coordinate).

The CPU 25 centrally controls each section of the graph display device 1. Specifically, the CPU 25 expands programs specified from a system program stored in the storage section 24 and various application programs, and executes various processing in coordination with the expanded programs.

[Graph Display Control Processing]

Next, the graph display control processing executed by the graph display device 1 is described with reference to FIG. 2.

FIG. 2 is a flowchart describing the operation of the graph display control processing. When the instruction to execute the graph display control processing is input through the input section 22 by the user, the graph display control program 240 is read out from the storage section 24 and suitably expanded. With this, the graph display control processing is performed by the CPU 25 in coordination with the graph display control program 240.

In the graph display control processing, as shown in the diagram, first, the CPU 25 inputs variables x, y for a function formula based on user operation (step S1). Then, the CPU 25 sets the coordinate system of the variables x, y in the display screen of the display 210 according to user operation to draw a graph of the function formula on the display 210 (step S2). The user in step S1 may select and input the function formula from the function formula data group 241 stored in the storage section 24.

Next, the CPU 25 displays the tracing pointer T (see FIG. 3B) on the graph according to user operation (step S3).

Next, the CPU 25 judges whether the coefficient of each parameter in the function formula is an integer or a fraction of an integer (step S4), and when it is judged that the coefficient is neither (step S4; No), in other words, when the coefficient is more complicated, the processing advances to normal tracing processing.

In step S4, when it is judged that the coefficient of each parameter in the function formula is an integer or a fraction of an integer (step S4; Yes), the CPU 25 sets the x-coordinate of the tracing pointer T to an initial value (for example, x = 0) (step S5).

Next, the CPU 25 judges whether it is possible to display the x-coordinate in a true value state by using a radical root, a fraction, "π", etc. (step S10).

In step S10, when it is judged that it is possible to display the x-coordinate in a true value state (step S10; Yes), the CPU 25 specifies the point where the tracing pointer T is positioned as a specified point, assigns the x-coordinate of the tracing pointer T to the function formula to calculate the y-coordinate of the tracing pointer T, and judges whether it is possible to display the calculated result of the y-coordinate in the true value state by using a radical root, a fraction, "π", etc. (step S11). When it is judged that the above display is possible (step S11; Yes), the processing advances to the later described step S16.

When it is judged that it is not possible to display the x-coordinate in the true value state in step S10 (step S10; No), and it is judged that it is not possible to display the calculated result of the y-coordinate in the true value state in step S11 (step S11; No), the CPU 25 judges whether there is a point with an x-coordinate which

can be displayed in the true value state using a radical root, a fraction, "π", etc. between the x-coordinate of the position of the tracing pointer T before moving, and the x-coordinate of the position of the tracing pointer T after moving (step S12).

In step S12, when it is judged that there is no point with an x-coordinate which can be displayed in the true value state (step S12; No), the CPU 25 specifies the point where the tracing pointer T is positioned at the present time as the specified point, assigns the x-coordinate in the function formula to calculate the y-coordinate of the tracing pointer T, and displays the coordinate of the tracing pointer T on the display 210 (step S14). Then, the processing advances to the later described step S21. In step S14, among the coordinates (x-coordinate, y-coordinate) of the tracing pointer T, the CPU 25 displays the coordinates which cannot be displayed in the true value state in each coordinate axis direction with a value of a rounded number within predetermined digits, in other words, as an approximate number.

In step S12, when it is judged that there is a point with an x-coordinate which can be displayed in the true value state (step S12; Yes), the CPU 25 specifies the point as the specified point, assigns the x-coordinate to the function formula to calculate the y-coordinate of the tracing point T, and judges whether it is possible to

display the calculated result of the y-coordinate in a true value state by using a radical root, a fraction, "π", etc. (step S13).

In step S13, when it is judged that it is not possible to display the calculated result of the y-coordinate in the true value state (step S13; No), the CPU 25 advances the processing to the above described step S14.

In step S13, when it is judged that it is possible to display the calculated result of the y-coordinate in the true value state (step S13; Yes), the CPU 25 displays on the display 210 the coordinates (x-coordinate, y-coordinate) of the tracing pointer T at the present time by using a radical root, a fraction, "π", etc. and displays a yellow plot P (see FIG. 3B, FIG. 4A) in a cross shape in a position of the tracing pointer T at the present time (step S16). The display state of the plot P and the coordinates of the plot P is maintained after the tracing pointer T moves. In step S16, the CPU 25 displays the coordinates in bold, red, underlined, etc. so that the coordinates can be displayed discriminated from the coordinates displayed in the above step S14. According to the present embodiment, when it is possible to display both the x-coordinate and the y-coordinate with the true values, both coordinate values are displayed with the true values. However, when it is possible to display only

either one of the x-coordinate or the y-coordinate with the true value, only such coordinate is displayed with the true value, and the other is displayed with the value of the rounded number within predetermined digits.

Next, the CPU 25 stores the coordinates of the tracing pointer T at the present time as the coordinates of the true value in the true value coordinate data table 243 (step S17).

Next, the CPU 25 judges whether the operation to move the tracing pointer T is performed (step S21). When it is judged that the operation is performed (step S21; Yes), the x-coordinate of the tracing pointer T is increased or reduced a predetermined amount and reset to move the tracing pointer T on the graph (step S22), and the processing advances to the above described step S10.

In step S21, when it is judged that the operation to move the tracing pointer T is not performed (step S21; No), the CPU 25 judges whether other operation is performed (step S23).

In step S23, when it is judged that other operation is not performed (step S23; No), the CPU 25 advances the processing to the above described step S21, and when it is judged that other processing is performed (step S23; Yes), the processing advances to other processing according to the operation.

[Operation Example]

Next, the operation of the above described graph display device 1 is described in detail with reference to the drawings.

(Operation Example 1)

First, in a state where a display mode (degree mode or radian mode) of an angle in trigonometric function is set to degree mode, as shown in FIG. 3A, the user inputs the function formula “Y1 = 3sinx” in the graph display device 1 (step S1). Then, when the user performs a predetermined operation, as shown in FIG. 3B, the graph of the function formula is drawn on the display 210 (step S2), and the tracing pointer T is displayed on the graph (step S3). According to the present operation example, the function formula “Y1 = 3sinx” is synonymous to “Y = 3sinx” and the number “1” added to “Y1” on the left side shows the number of the function formula.

Next, the coefficients of each parameter “y” and “x” in the function formula “Y1 = 3sinx” (y = 3sinx) are judged to be integer “1” (step S4; Yes), and the x-coordinate of the tracing pointer T is set to an initial value of “0” (step S5).

Next, it is judged that it is possible to display the x-coordinate in the true value state (step S10; Yes), the x-coordinate “0” of the tracing pointer T is assigned to

the function formula "Y1 = 3sinx" (y = 3sinx) to calculate the y-coordinate of the tracing pointer T, it is judged that it is possible to display the calculated result of the y-coordinate "0" in the true value state (step S11; Yes), and the coordinates of the tracing pointer T at the present time are displayed discriminated with an underline on the display 210 in the true value state (0, 0) and a yellow plot P in a cross shape is displayed in a position of the tracing pointer T at the present time (step S16). The display state of the plot P and the coordinates of the plot P (0, 0) is maintained after moving the tracing pointer T. The coordinates (0, 0) are stored in the true value coordinate data table 243 as the true value coordinates (step S17).

Next, when the user performs operation to move the tracing pointer T in the right direction (step S21; Yes), as shown in FIG. 3C, the x-coordinate of the tracing pointer T is increased a predetermined amount and reset to move the tracing pointer T in the right direction on the graph (step S22).

Next, it is judged that it is possible to display the x-coordinate "5" after movement in the true value state (step S10; Yes), the x-coordinate "5" of the tracing pointer T is assigned to the function formula "Y1 = 3sinx" (y = 3sinx) to calculate the y-coordinate of the tracing pointer T, and it is judged that it is not possible to

display the calculated result of the y-coordinate "0.26..." in a true value state (step S11; No). Next, it is judged whether there is a point with an x-coordinate which can be displayed in the true value state between the x-coordinate of the position of the tracing pointer T before movement and the x-coordinate of the position after movement (step S12). According to the present operation example, after it is judged that there are no such points (step S12; No), the coordinates (5, 0.26...) of the tracing pointer T at the present time are displayed on the display 210 (step S14).

Next, similar to the above, when the user performs operation to move the tracing pointer T in the right direction (step S21; Yes), as shown in FIG. 3D, the x-coordinate of the tracing pointer T is increased a predetermined amount and reset to move the tracing pointer T in the right direction on the graph (step S22).

Next, it is judged that it is possible to display the x-coordinate "25" after movement in the true value state (step S10; Yes), the x-coordinate "25" of the tracing pointer T is assigned to the function formula "Y1 = 3sinx" (y = 3sinx) to calculate the y-coordinate of the tracing pointer T, and it is judged that it is not possible to display the calculated result of the y-coordinate "1.26..." in the true value state (step S11; No). Next, it is judged whether there is a point with an x-coordinate

which can be displayed in the true value state between the x-coordinate of the position of the tracing pointer T before movement and the x-coordinate of the position after movement (step S12). According to the present operation example, after it is judged that there is no such point (step S12; No), the coordinates (5, 1.26...) of the tracing pointer T at the present time are displayed on the display 210 (step S14).

Next, similar to the above, when the user performs operation to move the tracing pointer T in the right direction (step S21; Yes), as shown in FIG. 4A, the x-coordinate of the tracing pointer T is increased a predetermined amount and reset to move the tracing pointer T in the right direction on the graph (step S22).

Next, it is judged that it is possible to display the x-coordinate "30" after movement in the true value state (step S10; Yes), the x-coordinate "30" of the tracing pointer T is assigned to the function formula "Y1 = 3sinx" (y = 3sinx) to calculate the y-coordinate of the tracing pointer T, and it is judged that it is possible to display the calculated result of the y-coordinate "1.5" in the true value state of "3/2" (step S11; Yes). The coordinates of the tracing pointer T at the present time are displayed discriminated with an underline in a true value state (30, 3/2) on the display 210, and the yellow plot P in a cross shape is displayed in the position of

the tracing pointer at the present time (step S16). The display state of the plot P and the coordinates of the plot P (30, 3/2) are maintained after moving the tracing pointer T. The coordinates (30, 3/2) are stored in the true value coordinate data table 243 as the true value coordinates (step S17).

Hereinafter, when the user performs the operation of moving the tracing pointer T in the right direction similar to the above (step S21; Yes), as shown in FIG. 4B, plot P and the coordinates of the plot P are displayed in the position of coordinates (45, $3\sqrt{2}/2$), (60, $3\sqrt{3}/2$), (90, 3) (step S16). The above coordinates are stored in the true value coordinate data table 243 as the true value coordinates (step S17). Here, when the user performs operation to display the content of the true value coordinate data table 243, as shown in FIG. 4C, the coordinates stored in the true value coordinate data table 243 as the true value coordinates are displayed.

(Operation Example 2)

First, in a state where a display mode of an angle in trigonometric function is set to degree mode, as shown in FIG. 5A, the user inputs the function formula "Y1 = 3sinX" (y = 3sinX) in the graph display device 1 (step S1). Then, when the user performs a predetermined operation, as shown in FIG. 5B, the graph of the function formula is

drawn on the display 210 (step S2), and the tracing pointer T is displayed on the graph (step S3).

Next, the coefficients of each parameter "y" and "x" in the function formula "Y1 = 3sinx" (y = 3sinx) are judged to be integer "1" (step S4; Yes), and the x-coordinate of the tracing pointer T is set to an initial value of "0" (step S5).

Next, it is judged that it is possible to display the x-coordinate in the true value state (step S10; Yes), the x-coordinate "0" of the tracing pointer T is assigned to the function formula "Y1 = 3sinx" (y = 3sinx) to calculate the y-coordinate of the tracing pointer T, it is judged that it is possible to display the calculated result of the y-coordinate "0" in the true value state (step S11; Yes), the coordinates of the tracing pointer T at the present time are displayed discriminated with an underline on the display 210 in the true value state (0, 0) and a yellow plot P in a cross shape is displayed in a position of the tracing pointer T at the present time (step S16). The display state of the plot P and the coordinates of the plot P (0, 0) is maintained after moving the tracing pointer T. The coordinates (0, 0) are stored in the true value coordinate data table 243 as the true value coordinates (step S17).

Next, when the user performs operation to move the tracing pointer T in the right direction (step S21; Yes),

as shown in FIG. 5C, the x-coordinate of the tracing pointer T is increased a predetermined amount and reset to move the tracing pointer T in the right direction on the graph (step S22).

Next, it is judged that it is not possible to display the x-coordinate "0.087..." after movement in the true value state (step S10; No). Then, it is judged there are no points with an x-coordinate which can be displayed in the true value state between the x-coordinate of the position of the tracing pointer T before movement and the x-coordinate of the position after movement (step S12; No). The x-coordinate "0.087..." of the tracing pointer T at the present time is assigned to the function formula "Y1 = 3sinx" (y = 3sinx) to calculate the y-coordinate "0.26..." of the tracing pointer T, and then the coordinates (0.087..., 0.26...) of the tracing pointer T are displayed on the display 210 (step S14).

Next, similar to the above, when the user performs operation to move the tracing pointer T in the right direction (step S21; Yes), as shown in FIG. 5D, the x-coordinate of the tracing pointer T is increased a predetermined amount and reset to move the tracing pointer T in the right direction on the graph (step S22).

Next, it is judged that it is not possible to display the x-coordinate "0.43..." after movement in the true value state (step S10; No). Then, it is judged that there

are no points with an x-coordinate which can be displayed in the true value state between the x-coordinate of the position of the tracing pointer T before movement and the x-coordinate of the position after movement (step S12; No). The x-coordinate "0.43..." of the tracing pointer T at the present time is assigned to the function formula "Y1 = 3sinx" (y = 3sinx) to calculate the y-coordinate "1.26..." of the tracing pointer T. Then, the coordinates (0.43..., 1.26...) of the tracing pointer T at the present time are displayed on the display 210 (step S14).

Next, similar to the above, when the user performs operation to move the tracing pointer T in the right direction (step S21; Yes), as shown in FIG. 6A, the x-coordinate of the tracing pointer T is increased a predetermined amount and reset to move the tracing pointer T in the right direction on the graph (step S22).

Next, it is judged that it is possible to display the x-coordinate "π/6" after movement in the true value state (step S10; Yes), the x-coordinate "π/6" of the tracing pointer T is assigned to the function formula "Y1 = 3sinx" (y = 3sinx) to calculate the y-coordinate of the tracing pointer T, and it is judged that it is possible to display the calculated result of the y-coordinate "1.5" in the true value state of "3/2" (step S11; Yes). The coordinates of the tracing pointer T at the present time are displayed discriminated with an underline in a true

value state ($\pi/6$, 3/2) on the display 210, and the yellow plot P in a cross shape is displayed in the position of the tracing pointer T at the present time (step S16). The display state of the plot P and the coordinates of the plot P ($\pi/6$, 3/2) are maintained after moving the tracing pointer T. The coordinates ($\pi/6$, 3/2) are stored in the true value coordinate data table 243 as the true value coordinates (step S17).

Hereinafter, when the user performs the operation of moving the tracing pointer T in the right direction similar to the above (step S21; Yes), as shown in FIG. 6B, plot P and the coordinates of the plot P are displayed in the position of coordinates ($\pi/4$, $3\sqrt{2}/2$) and ($\pi/3$, $3\sqrt{3}/2$) (step S16). The above coordinates are stored in the true value coordinate data table 243 as the true value coordinates (step S17). Here, when the user performs operation to display the content of the true value coordinate data table 243, as shown in FIG. 6C, the coordinates stored in the true value coordinate data table 243 as the true value coordinates are displayed.

According to the above described embodiment, as shown in steps S10, S11, and S16 of FIG. 2 and FIG. 3A to FIG. 6C, when the point on the function graph is specified by the tracing pointer T as the specified point, it is judged whether it is possible to display the x-coordinate and the y-coordinate in the true value state using a formula

including one or a plurality of a radical root, "π", and a fraction. When it is judged that it is possible to display the coordinates with the true value, the coordinates are displayed in the true value state using a formula including one or a plurality of a radical root, "π", and a fraction instead of the original displayed value of the rounded number. Therefore, it is possible to display the coordinates of the point on the graph with the true value.

As shown in steps S10, S21 of FIG. 2, when the tracing pointer T is moved in the x-axis direction on the function graph based on the user operation, if it is possible to display the x-coordinate of the tracing pointer T in the true value state, the point is specified as the specified point. Moreover, if the x-coordinate of the tracing pointer T after movement cannot be displayed in the true value state and there is a point with an x-coordinate which can be displayed in the true value state between the positions of the tracing pointer T before movement and after movement, the point is specified as the specified point. Therefore, it is possible to surely display the x-coordinate with the true value.

As shown in step S14 of FIG. 2, and FIG. 3A to FIG. 6C, unlike the coordinates displayed including the x-coordinate and/or y-coordinate in the approximate value state, the coordinates displayed in the true value state

are displayed distinguished with an underline, etc. Therefore, it is easy to confirm the coordinates displayed in the true value state among the points on the graph.

As shown in step S16 of FIG. 2, and FIG. 3A to FIG. 6C, the plot P is displayed in the coordinate position where the coordinates in each coordinate axis direction are displayed in the true value state, and the display of the coordinates in each coordinate axis direction in the true value state in the plot P is maintained. Therefore, it is easy to confirm the coordinates displayed in the true value state among the points on the graph.

The detailed configuration and the detailed operation of each element of the graph display device 1 of the present embodiment can be changed without leaving the scope of the present invention.

For example, the graph display control device regarding the present invention is described as the graph display device 1, however the present invention is not limited to the products as described above. The present invention can be applied to various electronic devices such as a scientific calculator, an electronic dictionary, a cellular telephone, a personal computer, a PDA (Personal Digital Assistant), a game machine and the like. The graph display control program 240 of the present invention can be stored in a memory card, CD, etc. which can be attached to and detached from the graph display device 1.

The vertical axis of the coordinate system is described as the Y-axis and the horizontal axis of the coordinate system is described as the X-axis, however, other coordinate axis names can be used. The coordinate system is described as the orthogonal coordinate system, however other types of coordinate systems can be employed, for example, an oblique coordinate system, a polar coordinate system, and the like. Further, the number of coordinate axes in the coordinate system is described to be 2, however, the number can be 3 or more.

Although various exemplary embodiments have been shown and described, the invention is not limited to the embodiments shown. Therefore, the scope of the invention is intended to be limited solely by the scope of the claims that follow and its equivalents.

In the claims which follow and in the preceding description of the invention, except where the context requires otherwise due to express language or necessary implication, the word "comprise" or variations such as "comprises" or "comprising" is used in an inclusive sense, i.e. to specify the presence of the stated features but not to preclude the presence or addition of further features in various embodiments of the invention.

It is to be understood that, if any prior art publication is referred to herein, such reference does not constitute an admission that the publication forms a part of the common general knowledge in the art, in Australia or any other country.

2013224718 26 Feb 2016

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A graph display control device comprising:

a display unit; and

a processor;

wherein the processor is configured to perform processes including:

setting a coordinate system with a plurality of variables and including coordinate axes in different directions for each variable, and controlling the display unit to display a function graph of the plurality of variables;

controlling to specify an arbitrary point on the function graph as a specified point based on user operation;

increasing or reducing by a predetermined amount a coordinate of a first variable among the plurality of variables of the specified point based on user operation;

calculating a coordinate of a second variable among the coordinates of the plurality of variables on the function graph corresponding with the increased or reduced coordinate of the first variable, and specifying a point of the increased or reduced coordinate of the first variable and the calculated coordinate of the second variable as a specified point after movement;

as judging processing (i), judging whether it is possible to display the coordinates of the specified point after movement in a true value state;

when it is judged that it is not possible to display

the coordinates of the specified point after movement in the true value state, as judging processing (ii), judging whether there is a coordinate of the first variable that can be displayed in a true value state between the coordinate of the first variable of the specified arbitrary point on the graph and the coordinate of the first variable of the specified point after movement;

when it is judged that there is a coordinate of the first variable that can be displayed in the true value state between the coordinate of the first variable of the specified arbitrary point on the graph and the coordinate of the first variable of the specified point after movement, specifying the coordinate of the first variable that can be displayed in the true state as a true value first variable coordinate, and calculating a coordinate of a second variable among coordinates of the plurality of variables on the function graph corresponding to the true value first variable coordinate;

as the judging processing (iii), judging whether the coordinate of the second variable corresponding to the calculated true value first variable coordinate can be displayed in a true value state; and

controlling the display unit to display the coordinates of the specified point of the true value first variable coordinate and the coordinate of the second variable corresponding to the true value first variable coordinate.

2. The graph display control device according to claim 1,

2013224718 26 Feb 2016

wherein,

the judging processing (i) is processing that judges whether the coordinate of the specified point after movement can be displayed in a true value state using a formula including one or a plurality of a radical root, π, and a fraction;

the judging processing (ii) is processing that judges whether there is the coordinate of the first variable that can be displayed in the true value state using the formula including one or a plurality of a radical root, π, and a fraction between the coordinate of the first variable of the specified arbitrary point on the graph and the coordinate of the first variable of the specified point after movement;

the judging processing (iii) is processing that judges whether the coordinate of the second coordinate corresponding to the calculated true value first variable coordinate can be displayed in the true value state using the formula including one or a plurality of a radical root, π, and a fraction; and

the controlling of the display unit to display in the true value state the coordinates of the specified point of the true value first variable coordinate and the coordinate of the second variable corresponding to the true value first variable coordinate and the coordinate of the second variable corresponding to the true value first variable coordinate in the true value state using the formula including one or a plurality of a radical root, π, and a fraction.

3. The graph display control device according to claim 1, wherein the processor is configured to perform processes including,

when it is judged in the judging processing (i) that the coordinates of the specified point after movement can be displayed in the true value state, controlling the display unit to display the coordinates of the specified point after movement in the true value state.

4. The graph display control device according to claim 1, wherein the processor is configured to perform processes including,

registering in a table the true value first variable coordinate and the coordinate of the second variable corresponding to the true value first variable coordinate as true value coordinates.

5. A graph display control method of an electronic device including a display unit, the method including:

setting a coordinate system with a plurality of variables and including coordinate axes in different directions for each variable, and controlling the display unit to display a function graph of the plurality of variables;

specifying an arbitrary point on the function graph as a specified point based on user operation;

increasing or reducing by a predetermined amount a coordinate of a first variable among the plurality of

2013224718 26 Feb 2016

variables of the specified point based on user operation;

calculating a coordinate of a second variable among the coordinates of the plurality of variables on the function graph corresponding with the increased or reduced coordinate of the first variable, and specifying a point of the increased or reduced coordinate of the first variable and the calculated coordinate of the second variable as a specified point after movement;

as judging processing (i), judging whether it is possible to display the coordinates of the specified point after movement in a true value state;

when it is judged that it is not possible to display the coordinates of the specified point after movement in the true value state, as judging processing (ii), judging whether there is a coordinate of the first variable that can be displayed in a true value state between the coordinate of the first variable of the specified arbitrary point on the graph and the coordinate of the first variable of the specified point after movement;

when it is judged that there is a coordinate of the first variable that can be displayed in the true value state between the coordinate of the first variable of the specified arbitrary point on the graph and the coordinate of the first variable of the specified point after movement, specifying the coordinate of the first variable that can be displayed in the true state as a true value first variable coordinate, and calculating a coordinate of a second variable among coordinates of the plurality of variables on the function graph corresponding to the true

2013224718 26 Feb 2016

value first variable coordinate;

as the judging processing (iii), judging whether the coordinate of the second variable corresponding to the calculated true value first variable coordinate can be displayed in a true value state; and

controlling the display unit to display the coordinates of the specified point of the true value first variable coordinate and the coordinate of the second variable corresponding to the true value first variable coordinate.

6. A computer-readable storage medium having a graph display control program stored thereon for controlling a computer including a display unit and a user operation unit, wherein the program controls the computer to:

set a coordinate system with a plurality of variables and including coordinate axes in different directions for each variable, and control the display unit to display a function graph of the plurality of variables;

specify an arbitrary point on the function graph as a specified point based on user operation;

increase or reduce by a predetermined amount a coordinate of a first variable among the plurality of variables of the specified point based on user operation;

calculate a coordinate of a second variable among the coordinates of the plurality of variables on the function graph corresponding with the increased or reduced coordinate of the first variable, and specify a point of the increased or reduced coordinate of the first variable

and the calculated coordinate of the second variable as a specified point after movement;

as judging processing (i), judge whether it is possible to display the coordinates of the specified point after movement in a true value state;

when it is judged that it is not possible to display the coordinates of the specified point after movement in the true value state, as judging processing (ii), judge whether there is a coordinate of the first variable that can be displayed in a true value state between the coordinate of the first variable of the specified arbitrary point on the graph and the coordinate of the first variable of the specified point after movement;

when it is judged that there is a coordinate of the first variable that can be displayed in the true value state between the coordinate of the first variable of the specified arbitrary point on the graph and the coordinate of the first variable of the specified point after movement, specify the coordinate of the first variable that can be displayed in the true state as a true value first variable coordinate, and calculate a coordinate of a second variable among coordinates of the plurality of variables on the function graph corresponding to the true value first variable coordinate;

as the judging processing (iii), judge whether the coordinate of the second variable corresponding to the calculated true value first variable coordinate can be displayed in a true value state; and

control the display unit to display the coordinates of

the specified point of the true value first variable coordinate and the coordinate of the second variable corresponding to the true value first variable coordinate.

7. A graph display control program for controlling a computer including a display unit and a user operation unit, wherein the program controls the computer to:

set a coordinate system with a plurality of variables and including coordinate axes in different directions for each variable, and control the display unit to display a function graph of the plurality of variables;

specify an arbitrary point on the function graph as a specified point based on user operation;

increase or reduce by a predetermined amount a coordinate of a first variable among the plurality of variables of the specified point based on user operation;

calculate a coordinate of a second variable among the coordinates of the plurality of variables on the function graph corresponding with the increased or reduced coordinate of the first variable, and specify a point of the increased or reduced coordinate of the first variable and the calculated coordinate of the second variable as a specified point after movement;

as judging processing (i), judge whether it is possible to display the coordinates of the specified point after movement in a true value state;

when it is judged that it is not possible to display the coordinates of the specified point after movement in the true value state, as judging processing (ii), judge

whether there is a coordinate of the first variable that can be displayed in a true value state between the coordinate of the first variable of the specified arbitrary point on the graph and the coordinate of the first variable of the specified point after movement;

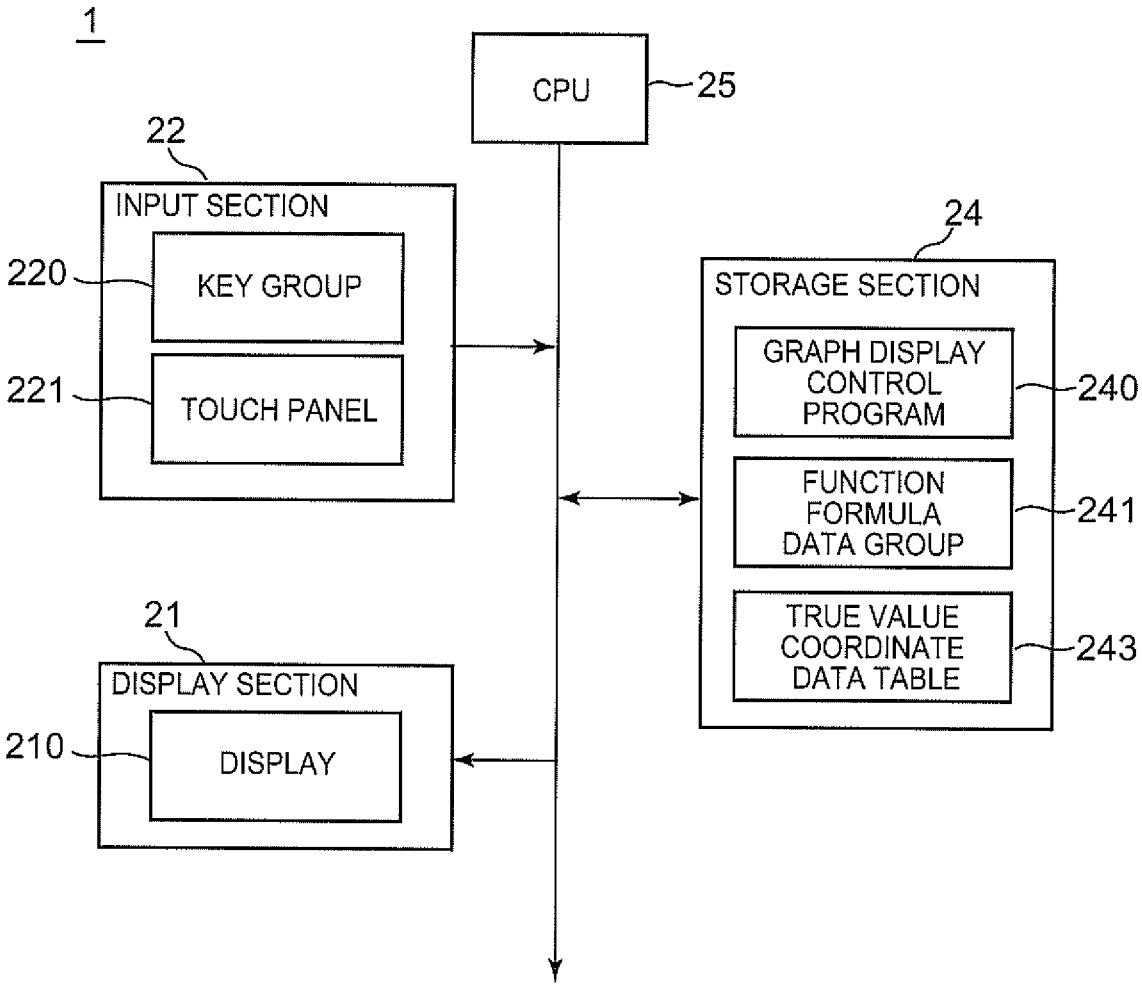
when it is judged that there is a coordinate of the first variable that can be displayed in the true value state between the coordinate of the first variable of the specified arbitrary point on the graph and the coordinate of the first variable of the specified point after movement, specify the coordinate of the first variable that can be displayed in the true state as a true value first variable coordinate, and calculate a coordinate of a second variable among coordinates of the plurality of variables on the function graph corresponding to the true value first variable coordinate;

as the judging processing (iii), judge whether the coordinate of the second variable corresponding to the calculated true value first variable coordinate can be displayed in a true value state; and

control the display unit to display the coordinates of the specified point of the true value first variable coordinate and the coordinate of the second variable corresponding to the true value first variable coordinate.

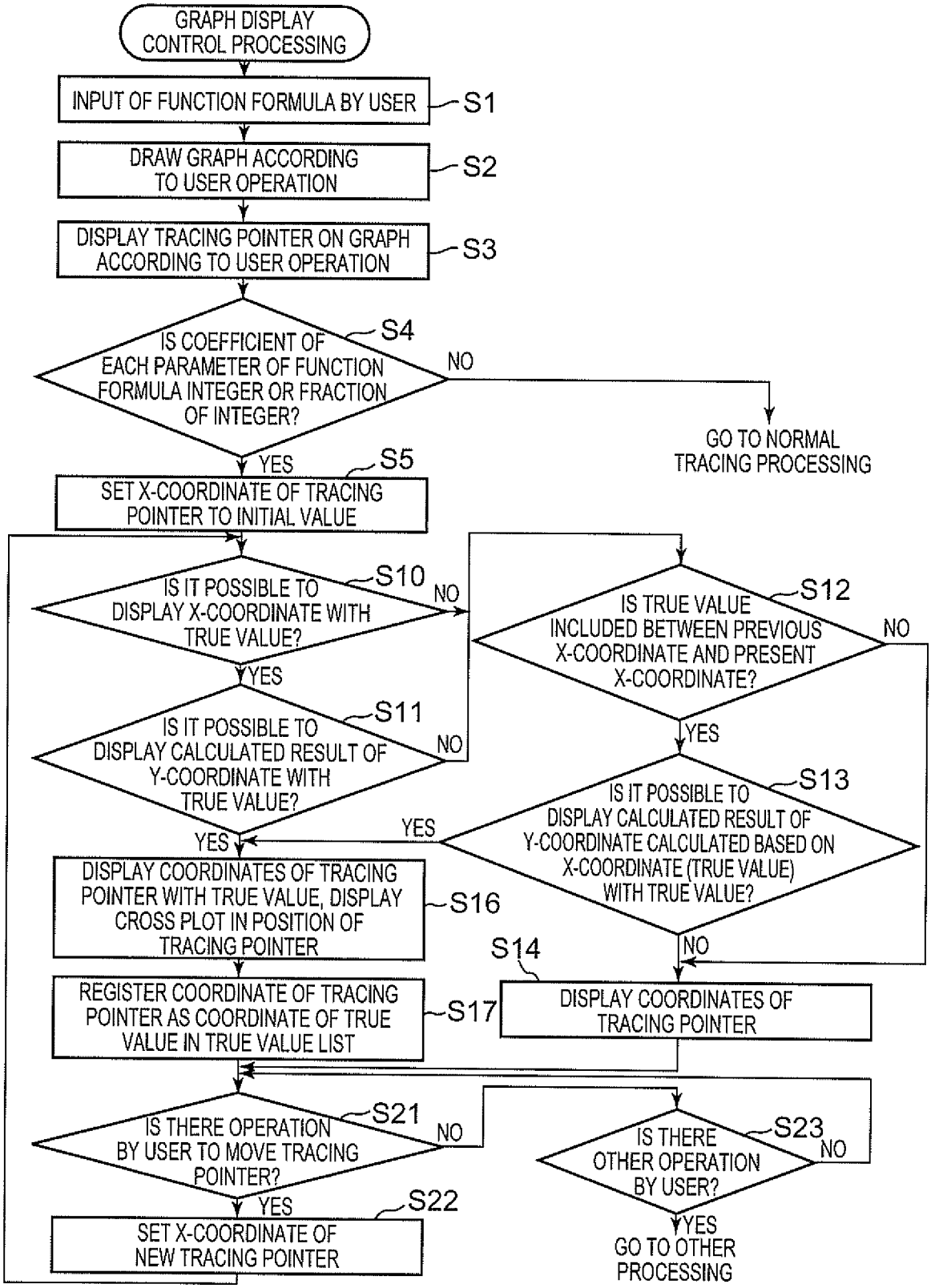
20132247 18 06 Sep 2013

FIG. 1



20132247 18 06 Sep 2013

FIG. 2



2013224718 06 Sep 2013

FIG. 3A

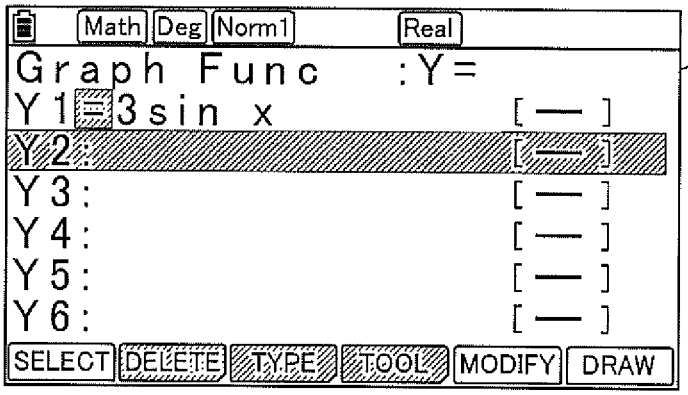


FIG. 3B

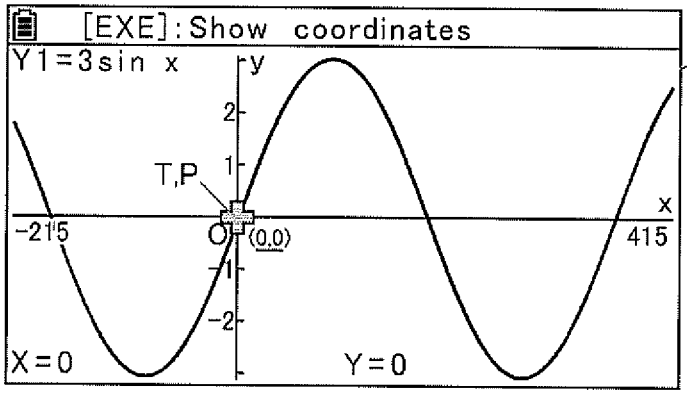


FIG. 3C

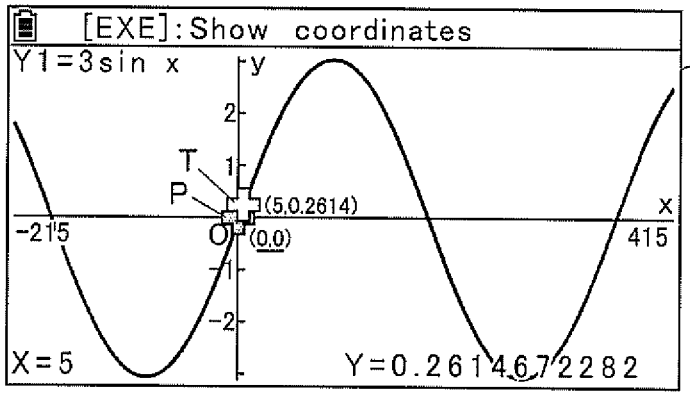
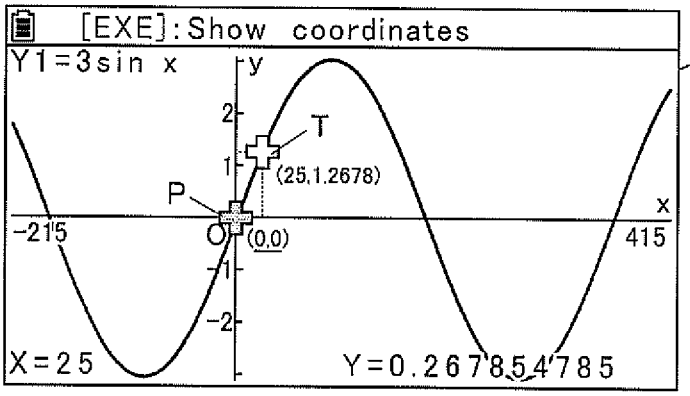


FIG. 3D



2013224718 06 Sep 2013

FIG. 4A

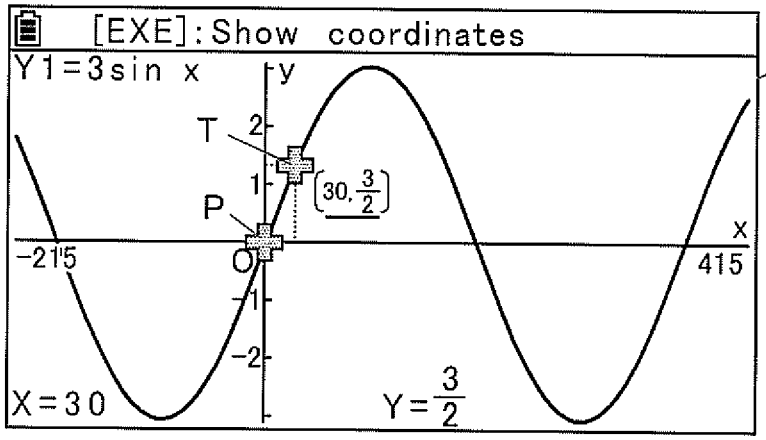


FIG. 4B

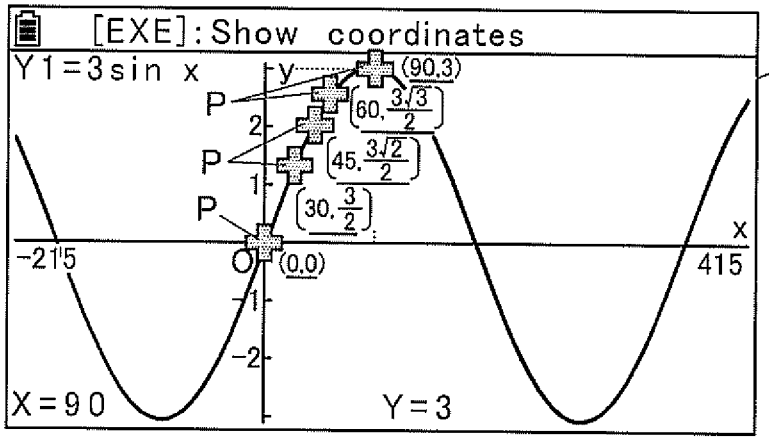


FIG. 4C

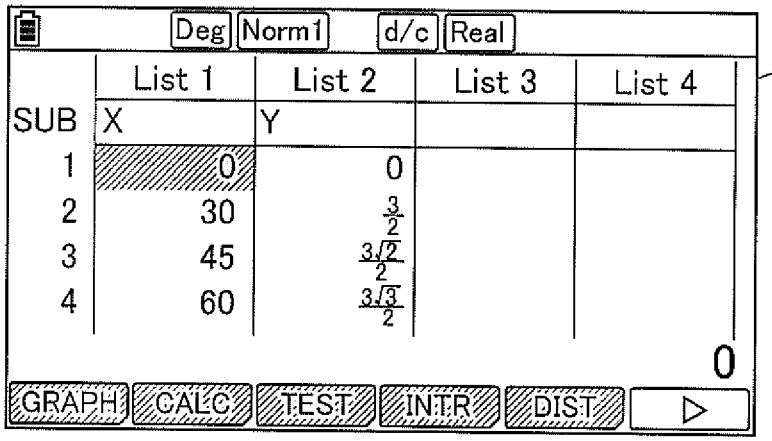


FIG. 5A

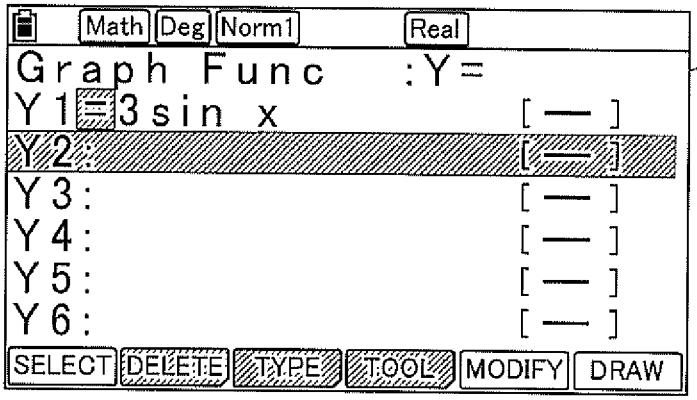


FIG. 5B

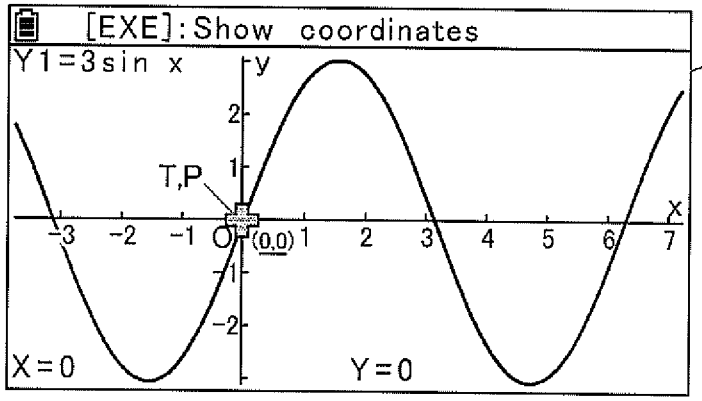


FIG. 5C

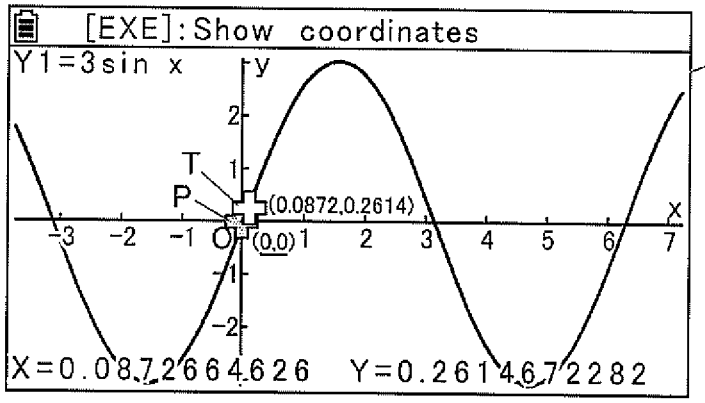
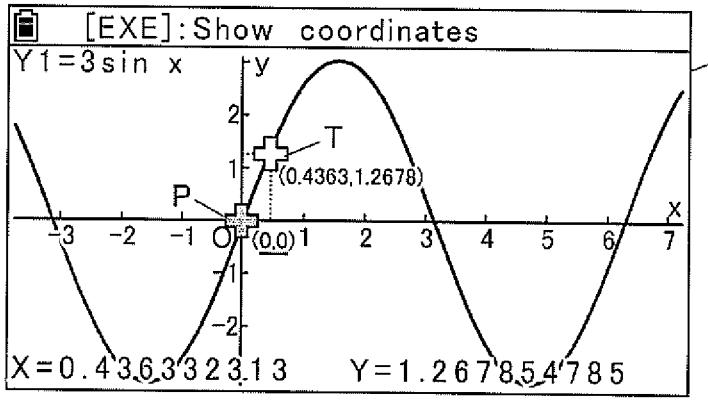


FIG. 5D



2013224718 06 Sep 2013

FIG. 6A

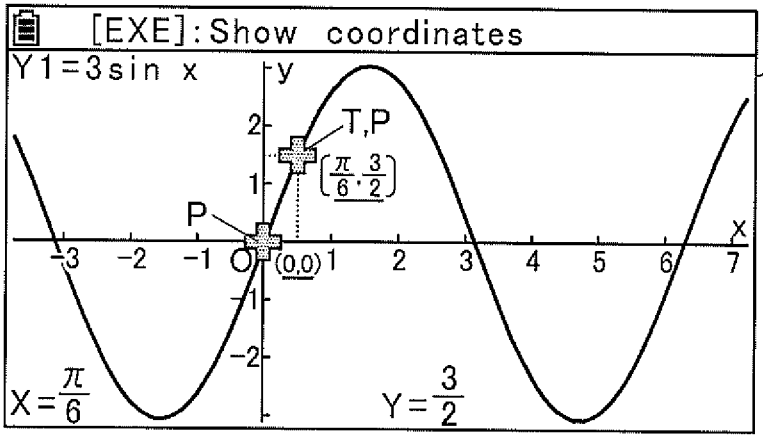


FIG. 6B

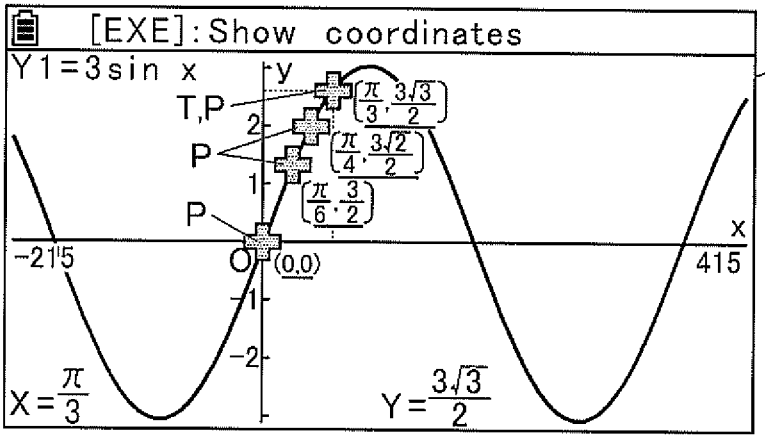


FIG. 6C