(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 388 048 A1

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
23.11.2011 Bulletin 2011/47

(51) Int Cl.:
A63B 43/00 *(2006.01)* ***G01C 21/16*** *(2006.01)*

(21) Application number: **10163267.7**

(22) Date of filing: **19.05.2010**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK SM TR
Designated Extension States:
BA ME RS

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(54) **Ball movement path measuring method**

(57) A ball movement path measuring method includes the steps of: preparing an operating unit and a measurement unit, mounting the triaxial accelerometer (C) in the object (O) to be measured for enabling the triaxial accelerometer (C) to define XYZ triaxial space coordinates, obtaining the data of a initial position of the XYZ axes at a first measuring time and the data of a reference position of the XYZ axes at a second measuring time and transmitting the obtained data to the operating unit, and comparing the reference position to the initial position and calculating the XYZ acceleration data, XYZ vector components of force and torsion force relative to each of XYZ axes after receipt of force subject to the contained angle between the coordinates data of the reference position and the coordinate data of the initial position and then using the XYZ acceleration data and the data of the weight and size of the object (O) to calculate the force experienced by the object (O), initial velocity, flight duration, flight height, flight distance and/or rotation speed.

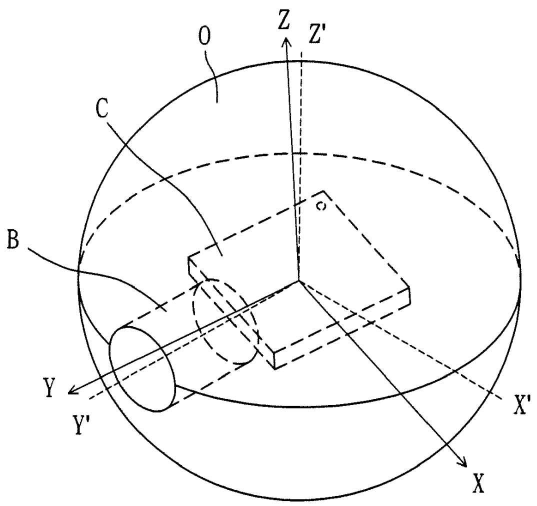

FIG. 1

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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a method for measuring the movement path of an object and more particularly, to a ball movement path measuring method.

2. Description of the Related Art

[0002] Normally, when wishing to know the movement path of an object such as golf ball or baseball ball that experiences a force during a ball game training or measurement, an immovable measuring reference must be established. In this case, the ball may be set in an apparatus that has a fixed measuring axis. For example, US6,551,194, entitled "Captive ball golf practice tee with three-dimension velocity and two-axis spin measurement" teaches measurement of movement and rotation of ball caused by a force by means of a fixed measuring axis. This measuring method can obtain some basic data required. However, the fixed measuring axis limits the degree of freedom of the ball when the ball experiences a force. Thus, the measured data may be deviated from the possible condition of movement when the ball experienced a force.

SUMMARY OF THE INVENTION

[0003] The present invention has been accomplished under the circumstances in view. It is the main object of the present invention to provide a ball movement path measuring method, which enables the object to move freely when experiences a force, thereby obtaining the data of XYZ acceleration data, XYZ vector components of force and torsion force relative to each of XYZ axes that are close to the actual condition of movement of the object.

[0004] To achieve this and other objects of the present invention, a ball movement path measuring method comprises the steps of preparing an operating unit and a measurement unit, the operating unit being an electronic apparatus having computing and display functions, the operating unit having stored in a memory therein the weight and size data of the object to be measured, the measurement unit being a triaxial accelerometer connectable to the operating unit and adapted for transmitting the measured data to the operating unit; mounting the triaxial accelerometer in the object to be measured for enabling the triaxial accelerometer to define XYZ triaxial space coordinates; obtaining the data of a initial position of the XYZ axes at a first measuring time and transmitting the data to the operating unit, and then obtaining the data of a reference position of the XYZ axes at at least one second measuring time and then transmitting the data to the operating unit; comparing the reference position to the initial position and calculating the XYZ acceleration data and the XYZ vector components of force and the torsion force relative to each of the XYZ axes after receipt of force subject to the contained angle between the coordinates data of the reference position and the coordinate data of the initial position, and then using the XYZ acceleration data and the data of the weight and size of the object to calculate the force experienced by the object.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005]

FIG 1 is a schematic drawing showing the relationship between a triaxial accelerometer and XYZ space coordinates in accordance with the present invention.

FIG. 2 is a schematic drawing showing the relationship between the absolute coordinates and the relative coordinates in accordance with the present invention.

FIG. 3 is a schematic oblique elevation, showing the relationship between the absolute coordinates and the relative coordinates in accordance with the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0006] Referring to FIGS. 1~3, ball movement path measuring method in accordance with the present invention comprises the steps as follows:

At first, prepare an operating unit and a measurement unit. The operating unit can be a computer, PDA, cell phone or any electronic device having calculation and display functions. Further, the operating unit comprises a memory that has stored therein weight and size data of the object **O** to be measured. The measurement unit is a triaxial accelerometer **C** connectable to the operating unit by a wired communication method. Alternatively, the triaxial accelerometer **C** of the measurement unit can be equipped with a battery and connectable to the operating unit by a wireless communication method.

[0007] Thereafter, set the triaxial accelerometer **C** in the object **O** to be measured, as shown in Fig. 1. Preferably, the triaxial accelerometer **C** is located on the center of gravity of the object **O.** When the triaxial accelerometer **C** is moved or rotated, its internal microstructure is changed, causing a capacitance variation, which is then converted into a specific output voltage signal for output. The triaxial accelerometer **C** defines XYZ triaxial space coordinates, as shown in FIG. 1. Because the triaxial accelerometer **C** is fixedly mounted in the object **O**, the generation of the XYZ triaxial space coordinates defines the positions of different parts of the object **O** in the space.

[0008] Thereafter, obtain the data of the initial position of the XYZ axes at the first measuring time where the coordinate data of the initial position of the XYZ axes is obtained before the object **O** experiences a force when the measuring time is zero and then the obtained data is transmitted to the operating unit. And then, obtain the data of a reference position of the XYZ axes at at least one second measuring time. A predetermined length of time after the object **O** experienced a force, the position XYZ is changed, for example, moved to the position X'Y'Z', as indicated by the imaginary line in FIG. 1. Measure the position X'Y'Z' at this second measuring time to obtain the data of this reference position of the XYZ axes, and then transmit the measured data to the operating unit. The length of time between the first measuring time and the second measuring time is determined subject to a predetermined setting.

[0009] Thereafter, compare the reference position X'Y'Z' to the initial position XYZ, and calculate XYZ acceleration data and XYZ vector components of force and the torsion force relative to each of XYZ axes after receipt of force subject to the contained angle between the coordinates data of the reference position X'Y'Z' and the coordinate data of the initial position XYZ. Based on the XYZ acceleration data and the basic reference data of the weight and size of the object **O**, the force experienced by the object **O** and the initial velocity are obtained by the second law of motion, i.e., a body experiencing a force **F** experiences an acceleration **a** related to **F** by **F** = *m***a**, where *m* is the mass of the object **O.** Based on the initial velocity, we can obtain the data of: flight duration (t =

$$\frac{2V_o}{g}$$

), flight height (H =

$$\frac{V_o^2}{2g}$$

), flight distance (S = V_ot

$$-\frac{1}{2}$$

g t^2) and rotation speed.

[0010] According to the present invention, the timeline positions of the first measuring time and the second measuring time and the length of time between the first measuring time and the second measuring time can be determined subject to different settings. For example, the first measuring time can be set at a time point prior to the object experienced an external force, and the second measuring time can be set at 0.5 second after the object experiences an external force. Alternatively, first measuring time can be set at 0.1 second after the object experienced an external force, and the second measuring time can be set at 0.5 second after the object experienced an external force.

[0011] The setting of the predetermined length of time can be the data measured from the start point till the end point of a predetermined length of time started from the time moment the object is stricken by a force. For example, measure the start position before the object experiences a force, and then measure the reference position 0.5 second after the object experienced a force. Alternatively, it can measure the data continuously after the object experienced a force. For example, the first measuring time can be a time point before the object experiences a force and the second measuring time can be any time point 0.1 second after the object experienced a force, or, the first measuring time can be a time point before the object experiences a force and the second measuring time, third measuring time and etc. can be the time points of equal time interval within a predetermined length of time after the object experienced a force. For example, the measurement at the second measuring time, third measuring time and etc. can be performed five times at a time interval of 0.02 second within the length of time 0.1 second.

[0012] The triaxial accelerometer **C** can be connected to a connection line through a connection port **B** thereof to obtain the necessary working power from an external power source and to output the measured data. Alternatively, the triaxial accelerometer **C** can be made having a built-in battery and adapted for outputting the measured data by a wireless transmission method.

[0013] Subject to the data measured, the acceleration, flight path, flight duration, and direction and angle of rotation can be obtained through a computation. The measuring method of the present invention eliminates the problem of a fixed measuring axis i.e., eliminates the factors that limit free movement of the object. Further, it is not necessary to reposition the object and to reset the reference position upon each calculation. The measuring method of the present invention can obtain data close to the actual movement of the object, assuring high accuracy of evaluation of the acceleration, flight path, flight duration and angle and direction of rotation of the object when the object experiences a force.

Claims

1. A ball movement path measuring method, being **characterized in** comprising the steps of:

   preparing an operating unit and a measurement unit, said operating unit being an electronic apparatus having computing and display functions,

said operating unit having stored in a memory therein the weight and size data of the object (O) to be measured, said measurement unit being a triaxial accelerometer (C) connectable to said operating unit and adapted for transmitting the measured data to said operating unit;
mounting said triaxial accelerometer (C) in the object (O) to be measured for enabling said triaxial accelerometer (C) to define XYZ triaxial space coordinates;
obtaining the data of a initial position of the XYZ axes at a first measuring time and transmitting the data to said operating unit, and then obtaining the data of a reference position of the XYZ axes at at least one second measuring time and then transmitting the data to said operating unit;
comparing the reference position to the initial position and calculating the XYZ acceleration data after receipt of force subject to the contained angle between the coordinates data of the reference position and the coordinate data of the initial position, and then using the XYZ acceleration data and the data of the weight and size of the object (O) to calculate the force experienced by the object (O).

2. The ball movement path measuring method as claimed in claim 1, being **characterized in that** the time points of said first measuring time and said at least one second measuring time is within the start point and end point of a predetermined length of time after said object (O) experienced a force.

3. The ball movement path measuring method as claimed in claim 1, being **characterized in that** the time point of said first measuring time is a time point before said object (O) experiences a force; the time point of each said second measuring time is a time point after said object (O) experienced a force.

4. The ball movement path measuring method as claimed in claim 1, being **characterized in that** the time point of said first measuring time is a time point after a first predetermined length of time after said object (O) experienced a force; the time point of each said second measuring time is a time point after a second predetermined length of time started after said first predetermined length of time.

5. The ball movement path measuring method as claimed in claim 1, being **characterized in that** said triaxial accelerometer (C) comprises a connection port (B) connected to a connection line set and adapted for obtaining the necessary working power from an external power source and outputting measured data.

6. The ball movement path measuring method as claimed in claim 1, being **characterized in that** said triaxial accelerometer (C) has a built-in battery and configured to output measured data wirelessly.

7. The ball movement path measuring method as claimed in claim 1, being **characterized in that** said triaxial accelerometer (C) is configured to use the measured XYZ acceleration data and the basic reference data of the weight and size of said object (O) for calculating at least one of the data of initial velocity, flight duration, flight height, flight distance and rotation speed.

8. The ball movement path measuring method as claimed in claim 1, being **characterized in** further calculating the XYZ vector components of force to calculate the force experienced by the object (O).

9. The ball movement path measuring method as claimed in claim 8, being **characterized in** further calculating the torsion force relative to each of the XYZ axes to calculate the force experienced by the object (O).

10. The ball movement path measuring method as claimed in claim 1, being **characterized in** further calculating the torsion force relative to each of the XYZ axes to calculate the force experienced by the object (O).

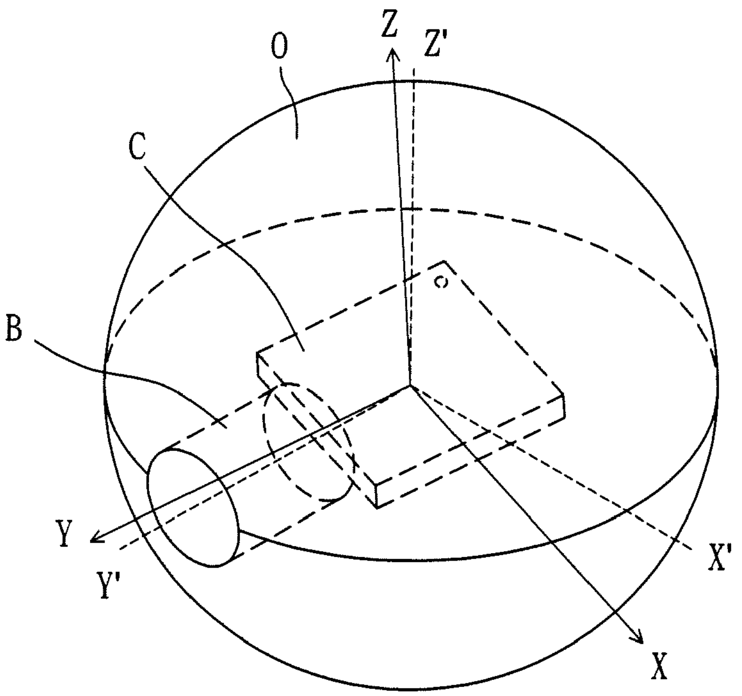

FIG. 1

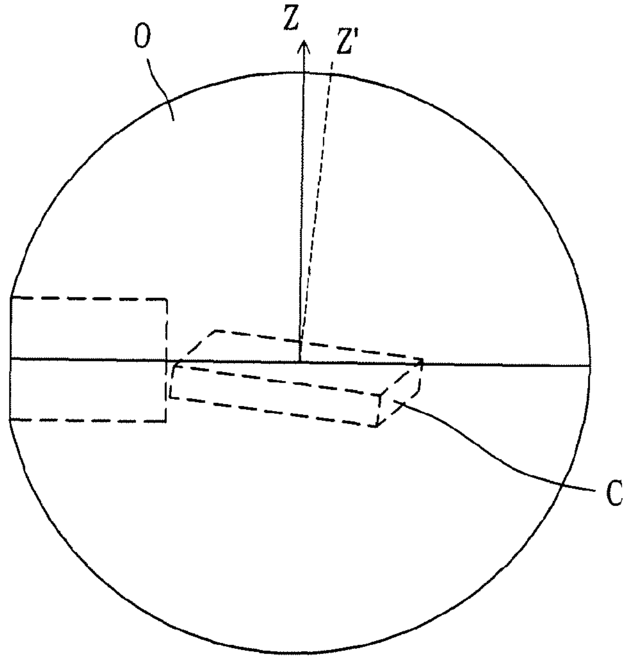

FIG. 2

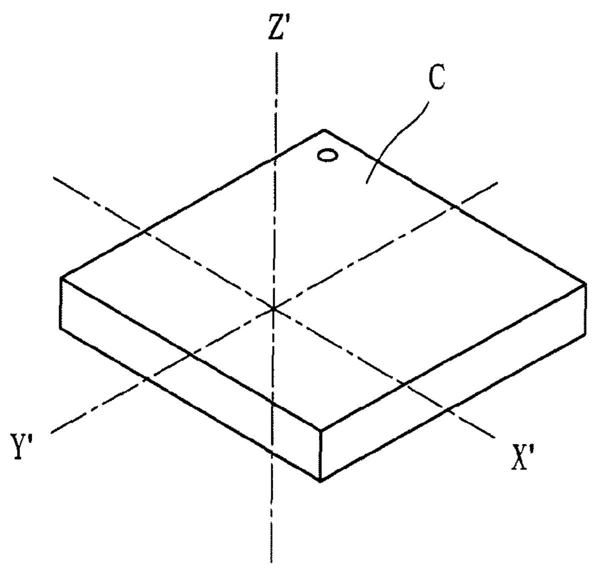

FIG. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 10 16 3267

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	US 2009/029754 A1 (SLOCUM ADAM [US] ET AL) 29 January 2009 (2009-01-29) * figures 1,3,5 *	1-10	INV. A63B43/00 G01C21/16
Y	US 2007/059675 A1 (KUENZLER UDO [DE] ET AL) 15 March 2007 (2007-03-15) * paragraphs [0101], [0102] *	1-10	
A	GB 2 440 510 A (SANGHA PARM [GB]) 6 February 2008 (2008-02-06) * page 3, lines 25-28 *	5	
A	DE 10 2006 013732 A1 (FRAUNHOFER GES FORSCHUNG [DE]) 19 July 2007 (2007-07-19) * paragraphs [0052], [0054] *	1	
A	FR 2 885 816 A1 (BOSCHAT DANIEL [FR]; RIVET JEAN JACQUES [FR]; JEREMIE ROGER [FR]) 24 November 2006 (2006-11-24) * page 1, line 26 - page 2, line 5 * * page 2, line 22 - page 3, line 9; figures *	1	TECHNICAL FIELDS SEARCHED (IPC)
A	US 2007/178967 A1 (ROSENBERG LOUIS B [US]) 2 August 2007 (2007-08-02) * paragraph [0108] *	1	A63B G01C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	8 November 2010	Jones, Mark

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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08-11-2010

Patent document cited in search report		Publication date	Patent family member(s)			Publication date
US 2009029754	A1	29-01-2009	NONE			
US 2007059675	A1	15-03-2007	AT	422949	T	15-03-2009
			AT	420703	T	15-01-2009
			CN	101198382	A	11-06-2008
			CN	101232923	A	30-07-2008
			DE	102005036355	A1	01-02-2007
			EP	1909925	A1	16-04-2008
			EP	1866039	A1	19-12-2007
			WO	2007014700	A1	08-02-2007
			WO	2007014701	A1	08-02-2007
			WO	2007014702	A1	08-02-2007
			ES	2321339	T3	04-06-2009
			ES	2319693	T3	11-05-2009
			JP	2009503466	T	29-01-2009
			JP	2009503468	T	29-01-2009
			US	2007060425	A1	15-03-2007
			US	2007191083	A1	16-08-2007
GB 2440510	A	06-02-2008	WO	2008015465	A1	07-02-2008
DE 102006013732	A1	19-07-2007	NONE			
FR 2885816	A1	24-11-2006	NONE			
US 2007178967	A1	02-08-2007	NONE			

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 6551194 B **[0002]**