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(54) **Helmet providing position feedback**

(57) A system for optimizing a rider's head position during riding, said system comprising:
a helmet (1) comprising:
- an outer casing (2) designed to have a direction X_1 wherein said helmet has a drag (coefficient) lower than the drag (coefficient) of said helmet in any other direction;
- a sensor unit (3) integrated in the helmet enabling de-

termining a value corresponding to the angle between the direction X_1 and a predetermined direction X_{REF} defined in the plane defined by the field of gravity and the direction X_1 ;
- an output unit (4), providing an output signal to the helmet wearer in function of the value determined by the sensor unit.

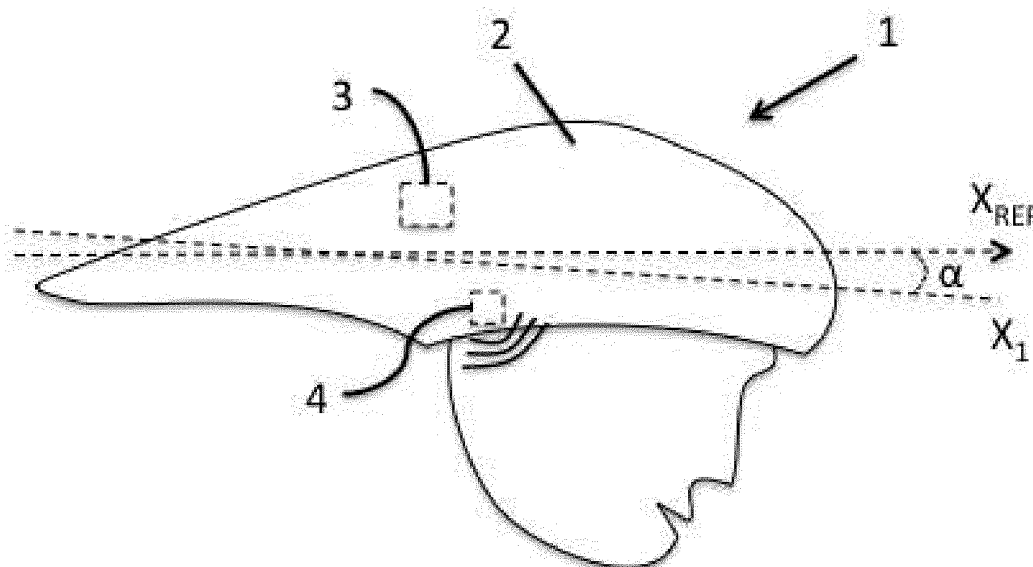


Figure 1

Description

Technical Field

[0001] The present invention concerns a sports helmet, in particular a helmet providing feedback to a wearer for improved aerodynamics.

Background for the Invention

[0002] Time trial cycling is a very specific cycling discipline wherein aerodynamics is a very important key to success and wherein aerodynamics is highly dependent on the position and posture of a rider on his bike. Time trial helmets are designed specifically for minimizing drag of the rider during cycling and have proven their efficiency. However, the position of the time trial helmet in view of the riding direction is critical for minimizing drag, as a non-optimal position of the helmet will have a negative impact on the drag of the rider.

[0003] Cyclists specializing in time trial cycling spent a lot of time and effort in improving their position including their head position when on the bike to identify the best position and to develop themselves to adopt and maintain that optimal position when riding.

[0004] Exercising is often performed by trial and error methods such as training in a velodrome, recording the ride and subsequently analysing the recorded images with specific image analysis software to compute the optimal position that is communicated to the rider who can adjust his position in a subsequent ride or during training on rolls. Other methods include driving down a hill and adjusting the head position to find the position resulting in the fastest down hill times, whereby the head position is filmed or registered by sensors provided on the cyclist's head. By repeating this exercise over and over again, the cyclist literally customises himself to adopt the most efficient head position. Other methods included training in wind tunnels and measuring the drag by means of sensors provided on the helmet or by means of camera's allowing determining the air movement around the cyclist's head.

[0005] Such exercises are very time consuming, have a slow learning curve and are expensive due to the need of people surveying the cyclist during the exercise to conduct the measurement and interpret the results. On top of the above facts it is necessary to repeat the exercise when changing bike or helmet to customise the cyclist to a readjusted position.

[0006] From the above it is clear that there is a need for time trial helmets providing instant feedback to a cyclist for adjusting his head's position for improved aerodynamics.

[0007] US51 58089 discloses a headband comprising a sensor for determining and instant informing a wearer of his head's position in view of the sagittal plane, to improve his posture and wellbeing.

[0008] US200401 71 969 discloses a helmet compris-

ing motion and/or position sensors and an indicator to provide the wearer with a recognizable feedback signal indicative of head or motion position.

Summary of the Invention

[0009] The present invention is defined in the independent claims. Preferred embodiments are defined in the dependent claims. In particular the invention concerns a 1. A system for optimizing a rider's head position during riding, said system comprising: a helmet comprising:

- an outer casing designed to have a direction X_1 wherein said helmet has a drag (coefficient) lower than the drag (coefficient) of said helmet in any other direction;
- a sensor unit integrated in the helmet enabling determining a value corresponding to the angle between the direction X_1 and a predetermined direction X_{REF} defined in the plane defined by the field of gravity and the direction X_1 ;

an output unit, providing an output signal to the helmet wearer in function of the value determined by the sensor unit.

[0010] The helmet preferably is a cycling helmet; skiing helmet or snow-board helmet, or equestrian or motorcycle helmet and in particular a time trial cycling helmet, road cycling helmet or triathlon helmet

[0011] The system further preferably comprises a sensor determining the inclination of the surface whereon the rider rides in the direction of the movement. In a even more preferred embodiment the system comprises at least three sensors, one integrated in the helmet, one to be provided on the rider, separate from the helmet and one to be provided on the vehicle of the rider, allowing determining the relative position of the rider and it's helmet in view of the vehicle.

[0012] Potentially the system further comprises at least one sensor allowing determining the wind direction in view of the helmets position and potentially also the forward speed of the rider.

[0013] The helmet may comprise a signal emitter for emitting an output signal to the output unit providing visual, audio and/or tactile feedback.

[0014] According to an alternative embodiment the system comprises a weight movably mounted in a tail of the helmet and an actuation and guiding means allowing moving the weight in said tail in view of the output of the sensor unit.

Brief Description of the Figures

[0015] Figure 1 schematically illustrates a time trial helmet with a system according to the present invention.

Definitions

[0016] Drag coefficient: The drag coefficient C_d is defined as:

$$C_d = \frac{F_d}{\frac{1}{2} \rho v^2 A}$$

where:

F_d is the drag force, which is by definition the force component in the direction of the flow velocity,
 ρ is the mass density of the fluid,
 v is the speed of the object relative to the fluid and
 A is the reference area.

Detailed Description of a Preferred Embodiment

[0017] Figure 1 schematically represents a time trial cycling helmet 1 for safeguarding a rider's head from head injury, yet comprising a outer casing designed such as lower the drag of the rider during racing.

[0018] It is known to design such helmet 1 with an outer casing 2 to have a preferential orientation during racing, in which position the casing design has a minimal drag coefficient and improves (lowers) drag of the rider during the race. For optimal effect, the rider should maintain his head in a position corresponding to the best position of the helmet for maximal gain.

[0019] The optimum orientation of the helmet in view of the moving direction thereof is defined by a direction X_1 , wherein said helmet has a drag (coefficient) lower than the drag (coefficient) of said helmet in any other direction.

[0020] In order to continuously assist the rider in maintaining his head in a optimal (lowest drag) position, the present invention concerns a system comprising at least one sensor unit 3 integrated in or provided on the helmet. The sensor unit, in its most basic form concerns an inclination sensor (mechanical or electronic) allowing determining a value corresponding to the angle between the X_1 direction and a predetermined direction X_{REF} defined in the plane defined by the field of gravity and the direction X_1 . It is clear that for optimum drag conditions, the helmet should be worn according to the helmet's safety guidelines. The X_{REF} direction in that case points towards the horizon in front of the rider when the helmet is worn according these safety guidelines that are described in eg EN1078:2012, CPSC 1203 or AS-NZS 2063.

[0021] In accordance with the present invention the system also comprises an output unit 4 allowing providing an output signal based on the value determined by use of the sensor, the output unit can be integrated in the

helmet or can be separate therefrom and provides direct feedback to the rider allowing the rider to immediately adapt his heads position in view of the output signal to regain his optimum position with lowest drag on the bike, in which position X_1 corresponds to X_{REF} and hence the angle α equals to 0° .

[0022] The output signal can be visualised to the rider, eg. on his eyewear or can be provided as an audio signal or a vibration on the rider's skin.

[0023] As represented in figure 3, the sensor 3 unit comprises a housing 5 defining an internal cavity wherein a ball 6 is provided that is free to roll in the cavity. The cavity is delimited by a curved wall section 7 whereon the ball rolls when the helmet is worn according to the safety guidelines in normal conditions (rider sitting on his bike).

[0024] At at least one, but preferably two sides of the internal cavity, in the X_1 direction, sensors 8 are provided that generate an output signal on contacting the ball. As such when the helmet tilts in view of the field of gravity in the X_1 direction and the angle between X_1 and X_{REF} increases, the ball rolls in that direction and will contact one of the two sensors 8 thereby actuating one of the sensors to generate a signal that is translated in a real-time output to the rider.

[0025] It is clear that the slope of the curved wall section 7 and position of the sensors 8 in the cavity of the sensor unit 3 will determine the threshold value of the angle α over which X_1 may tilt in view of X_{REF} before a signal is generated.

[0026] According to other embodiments the sensor unit comprises a gyroscope or an accelerometer allowing measuring tilting of the helmet in a plane defined by the direction X_1 and the field of gravity as this is the most difficult angle for a rider to maintain during a race, ie. the inclination of the head in an upward and downward direction. Alternatively the sensor unit comprises IR distance sensors or sound sensors directed to the back of the rider when the helmet is worn according to its safety instructions. Such sensors allow computing the distance and position of the helmet relative to the rider's body, and as such determining or estimating a value corresponding to the angle between the direction X_1 and a predetermined direction X_{REF} .

[0027] In accordance with another embodiment and as represented in figure 2, the system comprises at least two sensor units 3, 3', the first sensor unit 3 integrated in the helmet and a second sensor unit 3' to be provided on the rider, preferably on his back in close vicinity of the tail of the time trial helmet.

[0028] In this case both sensors units can be distance measuring units determining the distance between both sensor units, whereby the measured distance corresponds to a value indicating the direction X_1 and a pre-set distance corresponds to the value X_{REF} . An output unit generating an output signal as part of the system will provide real-time feedback to the rider allowing maintaining or regaining his optimal lowest drag position during

racing.

[0029] In yet another alternative embodiment the system comprises at least one sensor unit (an inclination sensor) integrated in or provided on the helmet and two sensor units separate from the helmet, one to be provided in a predetermined position on the riders body and one to be provided on a predetermined position on the bike, whereby the two separate sensor units allow indicating the position of the rider on his bike together with his head position. Such embodiment provides more information on the overall position of the rider and allows more detailed and extensive feedback for optimizing the rider's position during a race through the output unit.

[0030] In addition to the different embodiments of the system described above, additional sensor units can be provided on the helmet allowing real-time determining the wind direction and force acting on the helmet during a race and potentially also the forward speed of the rider (independent of the wind speed). The output from these additional sensor units can be processed and compared to test data generated with the helmet to determine the optimum X_{REF} corresponding to the optimum orientation of the helmet under the given circumstances. The measured X_1 value is in that case compared to a variable X_{REF} that is most representative for the actual racing conditions and allows for a more precise feedback to the racer.

[0031] Another additional sensor unit that can be integrated in the system is an inclination sensor provided on the bike or a GPS receiver, allowing determining the inclination of the path whereon the rider rides. The values determined by such sensor units again allows for a more accurate determination of the X_{REF} of the helmet in view of the racing conditions.

[0032] In the above described embodiments, the output unit can, apart from the real-time feedback as a visual, audio or vibration signal comprise an additional aid to the rider in terms of a mechanism changing the centre of mass of the helmet. Such output unit comprises an element of weight that is movably along the direction X_1 , integrated in the tail of the time trial helmet. The actuation of the movement is preferably a motor that is controlled by the sensor units (including a processor) of the system according to the present invention. By changing the centre of mass of the helmet, one can increase the comfort of the rider while maintaining his head in an optimum low drag position during racing.

[0033] The use of a system according to the present invention comprises determining the X_{REF} of the helmet for a given rider. Such determination will usually be done in a wind tunnel or by extensive on road testing. Once the X_{REF} is determined it is stored in the system for comparison with real time measurements of the X_1 direction.

[0034] In case the system comprises a multitude of sensor units allowing determining racing conditions, X_{REF} for a specific rider with his helmet is ideally determined under a broad variety of conditions, such that for each of these conditions the optimum X_{REF} is available to the system and can be compared to the real time meas-

ured X_1 .

[0035] Although described above as a system for optimizing a rider's head position during riding with a time trial helmet, it is clear that the system according to the present invention can be used with a multitude of helmets, such as other types cycling helmets, including triathlon, skiing helmets or snow-boarding helmets.

10 Claims

1. A system for optimizing a rider's head position during riding, said system comprising:

15 a helmet comprising:

- an outer casing designed to have a direction X_1 wherein said helmet has a drag (coefficient) lower than the drag (coefficient) of said helmet in any other direction;
- a sensor unit integrated in the helmet enabling determining a value corresponding to the angle between the direction X_1 and a predetermined direction X_{REF} defined in the plane defined by the field of gravity and the direction X_1 ;

25 an output unit, providing an output signal to the helmet wearer in function of the value determined by the sensor unit.

2. The system according to claim 1, wherein said helmet is a sports helmet.

35 3. The system according to claim 1 and 2, wherein said helmet is a cycling helmet; skiing helmet or snow-board helmet, or equestrian or motorcycle helmet..

40 4. The system according to claim 1, wherein said helmet is a time trial cycling helmet, triathlon helmet or road cycling helmet.

45 5. The system according to claim 1, comprising a sensor determining the inclination of the surface whereon the rider rides in the direction of the movement.

50 6. The system according to claim 1, comprising at least three sensors, one integrated in the helmet, one to be provided on the rider, separate from the helmet and one to be provided on the vehicle of the rider, allowing determining the relative position of the rider and its helmet in view of the vehicle.

55 7. The system according to claim 1, comprising at least one sensor allowing determining the wind direction in view of the helmets position.

8. The system according to claim 1, the helmet com-

prising a signal emitter for emitting an output signal to the output unit.

9. The system according to claim 3, comprising an element of weight movably mounted in a tail of the helmet and an actuation and guiding means allowing moving the weight in said tail in view of the output of the sensor unit.

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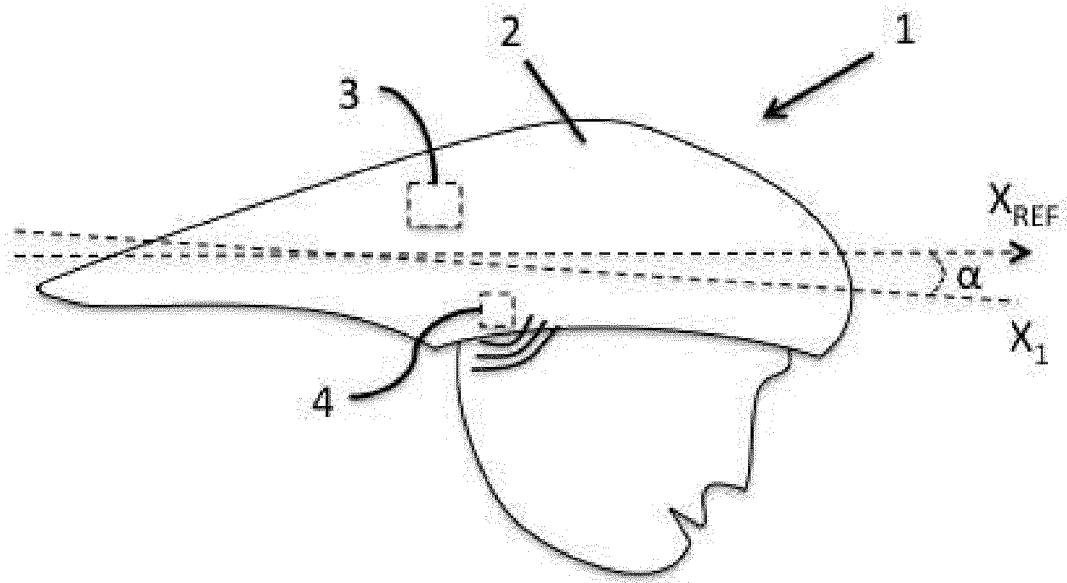


Figure 1

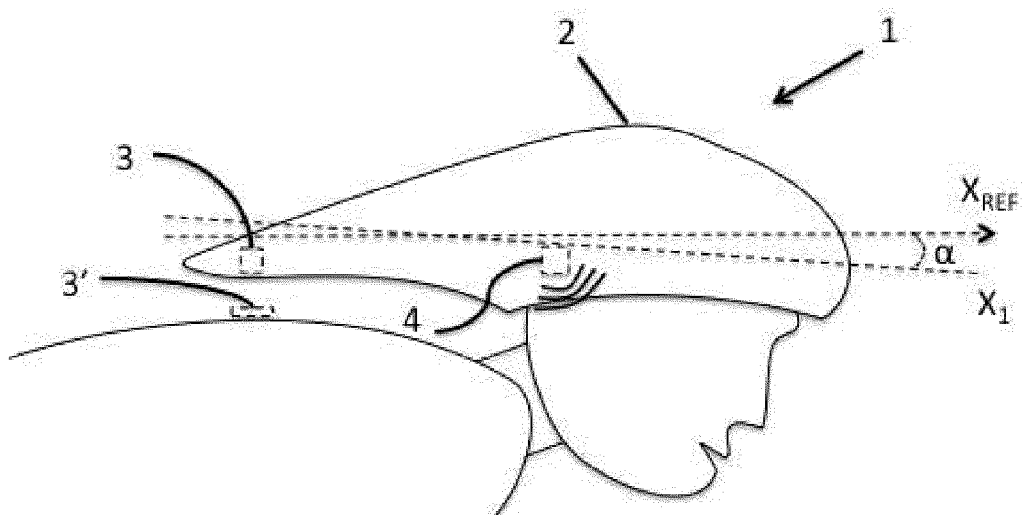


Figure 2

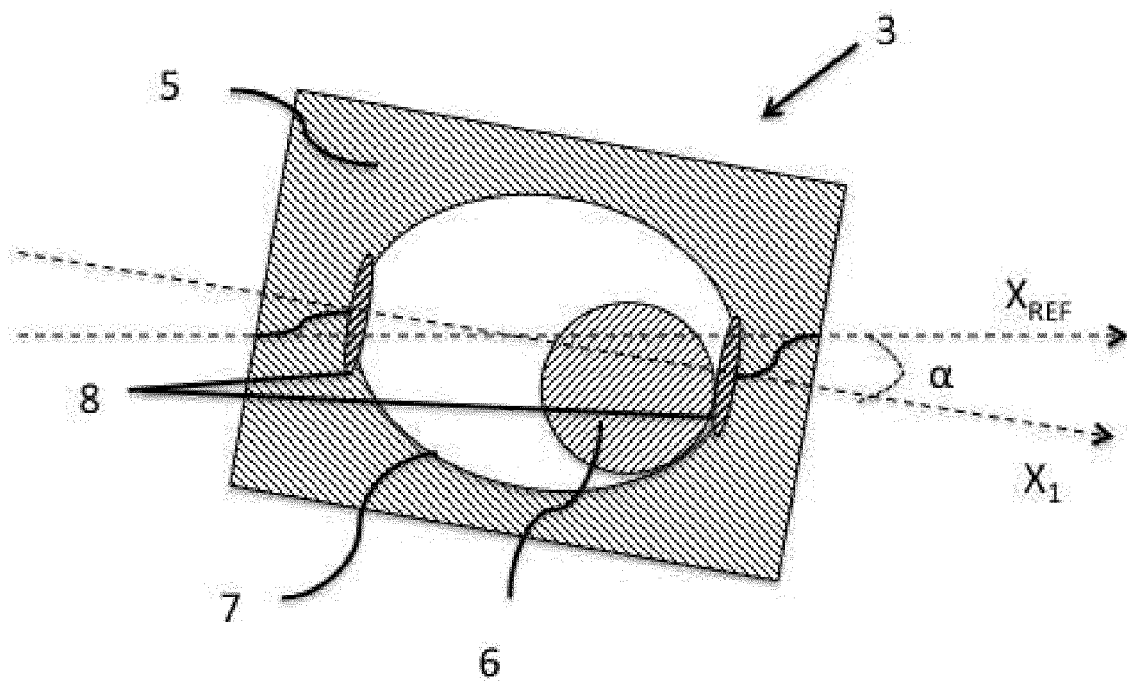


Figure 3



EUROPEAN SEARCH REPORT

Application Number
EP 14 17 5695

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2012/157243 A1 (GALLO CHRISTOPHER J [US]) 21 June 2012 (2012-06-21) * paragraphs [0025] - [0028], [0034], [0035]; figure 8 *	1-4,8	INV. A42B3/04
A	DE 10 2012 214061 A1 (UVEX SPORTS GMBH & CO KG [DE]) 15 May 2014 (2014-05-15) * claim 1; figure 1 *	1,4,9	
A	EP 1 616 600 A1 (ACTIMON GMBH & CO KG [DE]) 18 January 2006 (2006-01-18) * paragraphs [0026] - [0029]; figure 1 *	1,5-7	
A	US 2007/015611 A1 (NOBLE CHRISTOPHER R [US] ET AL) 18 January 2007 (2007-01-18) * paragraphs [0037], [0038]; figure 2a *	1	
A,D	US 2004/171969 A1 (SOCCI ROGER DAVID [US] ET AL) 2 September 2004 (2004-09-02) * claim 1; figure 4 *	1	
			TECHNICAL FIELDS SEARCHED (IPC)
			A42B A61B A63B B62J
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 20 August 2014	Examiner D'Souza, Jennifer
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 14 17 5695

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20-08-2014

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2012157243 A1	21-06-2012	NONE	
DE 102012214061 A1	15-05-2014	NONE	
EP 1616600 A1	18-01-2006	DE 102004034469 A1 EP 1616600 A1	16-02-2006 18-01-2006
US 2007015611 A1	18-01-2007	US 2007015611 A1 WO 2007008930 A2	18-01-2007 18-01-2007
US 2004171969 A1	02-09-2004	US 2002183657 A1 US 2004171969 A1 US 2004225236 A1	05-12-2002 02-09-2004 11-11-2004

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EPC FORM P0459

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 5158089 A [0007]
- US 20040171969 A [0008]