

FORCE SENSOR

DESCRIPTION

TECHNICAL FIELD

- 5 The disclosure relates to a force sensor, a sensor group having two force sensors, an assembly having a force sensor and a further sensor, a set having at least one force sensor for positioning on a head, a sensor holder for receiving at least one force sensor, and uses and methods for using these components, in particular for patients.

BACKGROUND

- 10 Force sensors of different basic technology are known.

BRIEF DESCRIPTION

- The inventors have recognized that it may be expedient for patients to position one or more force sensors on the body of the patient in order to carry out non-invasive detections of forces occurring on the body by means of the force sensors. By means of
15 these non-invasive detections of such forces, movements or extensions of muscles, veins, of the skull or other regions of the body can be determined without serious interventions. The inventors have recognized that, for such applications on the partly difficult-to-access and partly constantly and not always uniformly moving body of a patient, the force sensors according to the prior art are not sufficient to reliably detect such forces
20 occurring on the body.

It is therefore the object of the present disclosure to provide a force sensor which can detect forces more reliably.

This object is achieved by a force sensor according to main claim 1. The force sensor according to the invention is preferably for detecting forces occurring on a head, and the force sensor comprises: an active layer, wherein an electrical variable (e.g. electrical resistance or electrical voltage) of the force sensor depends on a force acting on the active layer in such a way that a change in the electrical variable is caused by a change in the force acting on the active layer, wherein the force sensor comprises an attachment which is arranged relative to the active layer in such a way that a force acting on the force sensor from the outside is conducted onto the active layer by means of the attachment (e.g. through the attachment). By virtue of the fact that the force sensor comprises an attachment which is arranged relative to the active layer in such a way that a force acting on the force sensor from the outside is introduced onto the active layer by means of the attachment, the reliability of the force detection is increased. The attachment contributes to the force acting on the force sensor reaching the active layer.

The attachment is conducive for the introduction of the force to be detected onto the active layer: by virtue of the attachment and its said arrangement relative to the active layer, it is possible to increase the probability that the force to be detected is also introduced onto the active layer. For example, it may not be possible in a reliable manner by circumstances of the surroundings of the force sensor to introduce the force to be detected directly onto the active layer, while the attachment with the said arrangement relative to the active layer makes it possible for the force to be detected nevertheless to be introduced onto the active layer by acting on the attachment. As a result, the force to be detected can be detected more reliably. The attachment is particularly advantageous in particular in the partly difficult-to-access regions of the partly constantly and not always uniformly moving body of a patient.

In addition, the attachment reduces the probability that forces to be detected which occur in regions outside the active layer or the active area of the active layer do not act on the active layer. In this respect, the attachment acts in a focusing manner with regard to the forces which occur. This also increases the reliability of the detection of the forces to be detected for this reason.

According to a preferred aspect of the force sensor according to the invention, the attachment can rest on a surface (e.g. the active area) of the active layer, which can be particularly effective with regard to the above advantages of the attachment. This surface

can be, for example, on a front side or a rear side of the active layer. The attachment can preferably be releasably fastened to the force sensor or to the active layer by a fastening means (e.g. a film or an adhesive such as an adhesive film).

In addition, the attachment reduces the susceptibility of the force sensor to interference and therefore further increases the reliability of the force detection. In surroundings of the force sensor with diverse movements, in particular in the region of the body of a patient (the patient rarely remains completely immobile), interference forces of diverse sources occur on account of constant movements, which interference forces can impede the detection of the actual force. By virtue of the attachment and its said arrangement relative to the active layer, it is possible to reduce the probability that forces not to be detected are also introduced onto the active layer. For example, the attachment can be placed such that the desired forces rather than the undesired forces are detected.

According to a preferred aspect of the force sensor according to the invention, a first cross section through the attachment can have a larger cross-sectional area than a second cross section through the attachment, wherein the second cross section is further away from the active layer and/or an active surface of the active layer than the first cross section. In other words, the attachment can taper in a direction away from the active layer and/or the active surface of the active layer. By virtue of this configuration of the shape of the attachment, the attachment can act in a selecting manner for the forces in such a way that the area to which the detected force originally couples to the force sensor is smaller than the active layer or the active area of the active layer. Therefore, the region in which forces which occur can be detected can be further limited and therefore the susceptibility to interference described above can be further reduced by detecting undesired forces.

The object is further achieved by a sensor group according to the invention, comprising: a first force sensor according to the invention and a second force sensor according to the invention, wherein the first force sensor and the second force sensor are electrically connected in parallel with one another. By virtue of the parallel connection of resistances of the two force sensors, the sensitivity of the detection of the forces can be increased, which is likewise conducive for the reliability of the force detection. By virtue of the parallel connection of the resistances of the two force sensors, the change in the detected force is amplified by the total resistance of the parallel-connected individual resistances of the force sensors.

Preferably, an assembly according to the invention is further provided, comprising: a force sensor according to the invention; a further sensor, which is designed to emit and/or to receive a signal via an active sensor surface of the further sensor; wherein the force sensor is mounted on a side surface, preferably opposite the active sensor surface, of the further sensor in such a way that the attachment, in particular the second side surface thereof, faces away from the side surface of the further sensor. By virtue of the arrangement of force sensor and further sensor in the assembly, the measurements with the further sensor and the measurements with the force sensor can be carried out in parallel and in the same spatial region. Thus, effects (for example movements or extensions on the body of the patient) which are associated with the force to be detected can be qualitatively taken into account in the measurement with the further sensor. This can make these measurements more accurate and/or more meaningful. For example, the further sensor can be an ultrasound probe with the ultrasound measurements, for example on the skull of the patient, which are carried out. In these ultrasound measurements, movements or extensions on the body of the patient which are detected by means of the force sensor can be qualitatively taken into account in the evaluation of the ultrasound measurements.

It may be desirable in connection with patients to attach one or more of the force sensors according to the invention either in each case alone or in each case in combination with a further sensor (or more) on a body part, such as a head, of a patient and to detect forces occurring there.

In previous approaches, sensors having a band, such as a head band on the head, for carrying out a diagnostic examination have been fastened to the body part. Such a band has an elastic band, which can be placed circumferentially on the body part. As a result of the elasticity of the band, a restoring force of the band leads to the band being pressed on the body part in a circumferential region and being fixed thereon. In the case of a head, the head band is preferably placed in a forehead region, a rear region and on opposite lateral regions of the head above the ears. Furthermore, up to now one or more sensor caps have often been provided on the band, which are designed in such a way that they each have an opening for passing through the head band on two opposite sides. The band and the sensor caps are set up in such a way that the sensor caps with sensors located therein are pressed between the band and the body part by the band on the body part. The sensor caps and the sensors can thus be held and positioned on the body part.

However, such solutions having bands have proven to be disadvantageous for a number of reasons for certain, in particular medical, examinations on the head, while bands or other holders can be used for other detections on the head or for examinations on other body parts.

5 Firstly, it is difficult to position the sensor caps with the sensors reproducibly on the head of the same patient. In the case of head injuries, a parameter of the head is observed on the same patient over a relatively long period of time. For this purpose, measurements on the head of the same patient are carried out at time intervals in order to determine how the state develops over time. For this purpose, the head band has to be removed
10 several times from the head of the patient and placed again for a new measurement. In this case, in the case of a subsequent measurement, it may happen that a reproduction of the sensor position from a preceding measurement does not succeed. This inaccuracy or lack of reproducibility of the sensor positions falsifies the measured values of the measurement series for certain examinations and can lead to a medical incorrect
15 estimation.

Furthermore, the positioning of the sensors on the head has proven to be too inaccurate for certain examinations, since the position of the sensors along the head band and the position of the head band on the head can vary. This leads to the orientation of the sensors being too inaccurate for certain examinations, as a result of which an observation
20 field of the sensors cannot be set accurately enough.

On the other hand, the sensors cannot be coupled to the head effectively enough for certain examinations. As a result of the head band, a uniform contact pressure is transmitted to the circumferential region of the head. This leads to only a small part of the contact pressure on the sensors being dispensed with and a higher contact pressure
25 than is generally necessary having to be set for coupling the sensors. This is disadvantageous in particular in the case of injuries to the head.

Furthermore, the contact pressure is dependent on a setting of the head band, as a result of which the contact pressure can vary for different measurements, which is disadvantageous in the comparison of the measured values for certain examinations.

30 Furthermore, the use of such a head band for certain examinations has proven to be disadvantageous, since the head has to be raised for placing the head band on the patient.

The raising of the head is not desirable in particular in the case of head injuries, since further injuries and pain can thus be caused for the patient or life-sustaining therapies (for example a ventilation tube) can be disrupted.

5 The inventors have found that reproducible positioning of the sensors on defined areas on the head has a great influence on the results of such examinations.

Preferably, therefore, a set for positioning sensors on opposite areas of a head is likewise provided according to the invention, the set comprising:

- one or more force sensors according to the invention;
- a headbracket, which is configured to at least partially extend around the head;
- 10 - sensor caps arranged on opposite areas of the headbracket, which are configured to receive at least one of the force sensors in each case; and
- a nosebracket connected to the headbracket, which is configured to support the headbracket on a back of the nose of the head. Two or more sensors improve the signal-to-noise ratio, but the constructions described herein are also possible with only one
- 15 force sensor.

Throughout this disclosure, the term “sensor cap” can be replaced by “sensor holder”. The term “sensor cap” is herein synonymous with “sensor holder”. The sensor holder can comprise a container for receiving and holding and possibly supporting the force sensor.

20 Against the background described above, the set according to the invention makes it possible to overcome the disadvantages of the head band mentioned at least for certain examinations and in particular to be able to carry out non-invasive diagnostic examinations better on the head of a patient.

The position of the sensors arranged in the sensor caps on the head is predetermined by the headbracket with the sensor caps arranged thereon. As a result of the fact that the

25 sensor caps are arranged on opposite areas of the headbracket, it is ensured that the sensors in the sensor caps lie against opposite areas of the head and are thus arranged symmetrically on the head and are also preferably aligned with respect to one another.

The headbracket is supported on the back of the nose by the nosebracket connected to the headbracket. The position of the headbracket with the sensor caps arranged thereon is thus aligned with the head of the patient on the basis of a predetermined reference point, i.e. the nose. Sensors on the head can thus be positioned more accurately at predetermined positions on the head by means of the set according to the invention.

Furthermore, the reproducibility of the areas on the head against which the sensors lie on the head is improved on the basis of the reference point, since the reference point, i.e. the position of the nose, does not change for a patient. In addition, the position of the reference point, i.e. the nose, on the head is very similar for different patients with similar head sizes, so that a reproducibility of the sensor positions between patients of similar head sizes can also be achieved.

Furthermore, the inventors have found that the contact pressure of the sensors on the head often has a further great influence on the results of diagnostic examinations.

According to the set according to the invention, the contact pressure with which the sensors in the sensor caps lie on the head is predetermined substantially by the headbracket. Since the head diameter does not change for an individual patient and the position of the sensors on the head is reproducible, the contact pressure of the sensors on the head is easily reproducible between individual examinations on the head of the patient. Furthermore, the head diameters for a class (for example children or adults) of patients are at least similar, so that the contact pressure for different patients of a class is at least similar.

Furthermore, the use of such a headbracket has proven to be particularly effective in practice in patients with head injuries. A headbracket can be placed on the head from one side. The placing of the set thus no longer compulsorily requires raising the head of a patient, which is advantageous for patients with a head injury.

In addition to the force sensors, further sensors can be received in the sensor caps, for example one force sensor and one further sensor per sensor cap in each case. The further sensor can comprise, for example, an emitter for emitting signals and/or a detector for receiving emitted signals. Conclusions about a parameter of the head, in particular within the skull, can be determined on the basis of the interaction of the signals with the head. In some aspects, an emitter is positioned on one side of the head and a detector is

positioned on an opposite side of the head in order to detect the emitted signals by the head. In other aspects, an emitter and a detector can each be positioned on one side of the head.

5 The set according to the invention has proven to be particularly expedient for the exemplary use of the non-invasive determination of a brain pressure. To determine the brain pressure, the sensors comprise an emitter as a sensor for emitting ultrasound signals and a detector as a sensor for receiving the emitted ultrasound signals, which can be positioned on the opposite areas of the head by means of the set. The brain pressure can be classified on the basis of the transit time of the ultrasound signals through the
10 head.

Further preferred aspects of the set will be explained below.

According to a preferred aspect, the nosebracket is connected to the headbracket in an area of the headbracket approximately centrally between the sensor caps.

15 By virtue of this relative arrangement of headbrackets, the set is adapted to the anatomy of a head in such a way that the sensor caps are aligned symmetrically on the head on the opposite areas. In particular because the position of the nose in an area is arranged approximately centrally in the face. By virtue of the arrangement of the nosebracket in an area approximately centrally between the sensor caps on the headbracket, the headbracket is centered on the head.

20 According to a preferred aspect, the headbracket at least partially extends around an axis in a first plane running perpendicular to the axis, wherein the nosebracket intersects the first plane, preferably in a direction approximately perpendicular to the first plane.

By virtue of this arrangement, the relative arrangement of headbracket and nosebracket is adapted particularly effectively to the anatomy of the head when, according to the
25 application, the headbracket partially extends around the head and the nosebracket rests on the back of the nose.

In some particularly preferred aspects, the nosebracket, starting from the headbracket, can extend in the direction approximately perpendicular to the first plane. The nosebracket can be formed, for example, approximately coaxially to the direction
30 approximately perpendicular to the first plane.

According to these aspects, the headbracket extends around the head approximately in a frontal region, preferably in a forehead region of the head, when the nosebracket is supported on the back of the nose. As a result, an upper half of the head is kept free for other medical measuring devices or invasive devices for the treatment of an injury.

- 5 In this aspect, a length of the nosebracket can be designed to be particularly short, as a result of which the stability of the set, in particular of the nosebracket, is improved.

According to a preferred aspect, the nosebracket has an end piece at an end opposite the headbracket, wherein the end piece has a preferably approximately bracket-shaped indentation aligned approximately along the axis, which is configured to prevent a
10 relative movement from the nosebracket to the back of the nose in a direction parallel to a frontal plane of the head and parallel to the first plane.

By means of an end piece designed in this way, a relative movement of the set relative to the head is reduced. The stability of an orientation of the set on the head is thus improved. As a result, the possibility of a change in position of the set on the head is
15 reduced.

According to a preferred aspect, the nosebracket, starting from the connection to the headbracket, has a length of 2 cm - 7 cm, preferably approximately 5 cm or less.

In particularly preferred embodiments, the length of the nosebracket is measured in a direction approximately transverse to the first plane between the approximately central
20 area of the headbracket between the sensor caps and an area of the nosebracket which, according to the application, rests on the back of the nose.

The positioning of the headbracket and thus of the sensor caps on the head is at least partially predetermined by the length of the nosebracket. The inventors have found that, by virtue of this configuration of the nosebracket, the anatomy of a head of a multiplicity
25 of patients is particularly imaged. The sensors can thus be positioned at predetermined positions on the head in the case of a large majority of patients.

According to a preferred aspect, the sensor caps have a distance of 10 cm - 17 cm, 11 cm - 16 cm or approximately 13 cm from the nosebracket.

In some particularly preferred embodiments, the distance along the headbracket between a sensor cap and the nosebracket is measured.

The positioning of the sensor caps on the head relative to the position of the nose is predetermined by the distance of the sensor caps from the nosebracket. The inventors
5 have further found that, by virtue of this configuration of the headbracket, the anatomy of the head of a multiplicity of patients is particularly imaged for positioning the sensor caps on the head. The sensor caps can thus be positioned at the predetermined positions on the head in the case of a large majority of patients.

For example, the headbracket can be designed in such a way that it can be placed
10 approximately parallel to a transverse plane of the head, with the result that the sensor caps are arranged in an area approximately above the ear canal on opposite areas of the head. In particularly preferred aspects, the headbracket can be designed in such a way that a sensor cap is arranged in an area between the T3 position and the T5 position, preferably at a distance of 3.5 - 4.5 cm from the T3 position, and a sensor cap is arranged
15 between the area of the T4 and the T6 position, preferably at a distance of 3.5 - 4.5 cm from the T4 position. In particular, one sensor cap in each case can be arranged in an area of the fascia of the M. temporalis.

According to a preferred aspect, one sensor cap in each case comprises a preferably approximately cylindrical recess for receiving a sensor, which has an opening on one side
20 and is at least partially delimited by the sensor cap on a bottom side of the sensor cap opposite the opening and on at least one side surface of the sensor cap.

In the use, a sensor is inserted into the recess of the sensor caps via the opening in the sensor caps. After the insertion, a sensor is arranged in the recess of a sensor cap. The sensor is then exposed on a front side through the opening of the sensor cap, so that the
25 sensor can rest with the front side directly on the head. On the other sides, the sensor is at least partially surrounded by the sensor cap, so that it is held in the sensor cap and can be pressed against the head by the sensor cap.

In particularly preferred aspects, a depth of the recess from the opening to the bottom side is dimensioned such that a sensor inserted into the recess at least partially protrudes
30 beyond an edge of the sensor cap extending around the opening.

The contact pressure exerted on the head by the headbracket can thus be focused on the sensors in the sensor caps.

According to a preferred aspect, the openings of the sensor caps face one another.

According to this aspect, sensors which are arranged in the recesses of the sensor caps located on opposite areas of the head are aligned with respect to one another. Since the sensors in the sensor caps lie directly on the head through the openings, it can be ensured that signals emitted and detected by the sensors reach the respective opposite sensor on a direct path through the head without passing through further sections, for example of the sensor cap.

According to a preferred aspect, the sensor cap has at a preferably approximately central position on the bottom side a preferably approximately hemispherical elevation directed in the direction of the opening, which represents a stop and/or adjustment aid for a sensor.

According to this aspect, the orientation of the sensor can adapt to a surface of the head, so that the sensor lies optimally on the surface of the head. A sensor located in the recess is pressed against the head by the sensor cap connected to the headbracket. The elevation forms a stop for a rear side of the sensor facing away from the head. Thus, a sensor strikes the elevation in a partial region of the rear side, wherein the remaining regions of the rear side, which do not strike the elevation, are exposed in the direction of the bottom side by the elevation. The sensor can thus adapt its orientation, so that this plane lies on the head when a pressure is exerted on the front side of the sensor by a surface of the head.

According to a preferred aspect, one sensor cap in each case has at least one lead-through opening into the recess through the at least one side surface, wherein the lead-through opening opens into the opening of the recess via a lead-through region.

A sensor can communicate with a computing unit, for example, via a sensor cable for exchanging signals. The sensor cable can be connected or connectable to the sensor. A sensor has a front side, which is configured to rest on a head, and a rear side opposite the front side. The cable can protrude from the sensor in a direction approximately perpendicular to a direction running perpendicular to the front side and the rear side.

If a sensor connected to a sensor cable is inserted into the sensor cap through the opening of the recess, the sensor cable can be inserted into the lead-through opening through the lead-through region at the same time as the sensor is inserted into the recess. The sensor cable is thus advantageously guided away from the sensor in the recess through the sensor cap. Furthermore, the cable is at least partially delimited circumferentially by the sensor cap, as a result of which a mobility of the sensor in the recess is restricted. For example, a rotation about the direction running perpendicular to the front side and the rear side is thus avoided.

According to a preferred aspect, the lead-through region has a taper with respect to a diameter of the lead-through opening.

If a sensor connected to a sensor cable is inserted into the recess through the lead-through region into the lead-through opening with simultaneous lead-through of the sensor cable connected to the sensor, the sensor cable overcomes the taper by exerting a force. If the sensor is positioned in the recess and the sensor cable is located in the lead-through opening, the taper prevents the sensor cable from sliding out of the lead-through opening over the lead-through region. A sensor connected to the sensor cable is thus prevented from sliding out of the recess of the sensor cap.

According to a preferred aspect, one sensor cap in each case has a further opening, which at least partially exposes the recess through the at least one side surface and/or through the bottom side.

According to this aspect, a sensor arranged in the recess is exposed laterally and/or on the rear side thereof at least partially through the further opening of the sensor cap surrounding the sensor. The regions of the sensor exposed by the further opening are thus accessible from outside the sensor cap. As a result, a sensor can be removed more easily from the recess of the sensor cap.

According to a preferred aspect, one sensor cap in each case has a further recess for receiving a magnet on a side opposite the opening of the recess.

The sensors can preferably be formed paramagnetically, preferably have a paramagnetic rear side. By positioning a magnet on the side of the sensor cap opposite the opening of the recess, the magnet and the sensor cap are pulled against one another by a magnetic

force, so that a force acts on the sensor in the direction of the bottom side and the sensor is held in the recess of the sensor cap.

According to a preferred aspect, the set comprises a magnet, which can be fastened to one of the sensor caps, preferably can be fastened in the further recess.

- 5 According to a preferred aspect, such a magnet can be fastened to the rear side of the sensor cap via an approximately clamp-shaped holder. According to a preferred aspect, the magnet can be fastened in the further recess, for example by means of an adhesive or a cover covering the further recess.

- 10 According to a preferred aspect, the set has at least three preferably clip-shaped markers, which can be fastened to the nosebracket, the headbracket and/or the sensor caps in areas different from one another.

These markers can be recognized in different imaging methods. A positioning of the set relative to the head can thus be reproduced in an image of the head with the set.

- 15 For example, the markers are formed such that the markers are visible in an MRI (magnetic resonance tomography) scan of the head with the set. The positioning of the set on the head is thus visible in the MRI scan. The examined areas in the head can thus be linked to spatial planes of the MRI scan.

- 20 Furthermore, a three-dimensional view in the visible area of a head with the set can be recorded. Such a view can preferably be recorded and created at different perspectives by means of a stereo camera or a camera.

- 25 In a further step, the three-dimensional view of the head with the set in the visible area and the image of the head with the set recorded by means of the MRI can be superimposed on one another on the basis of the markers. Information about the positioning of the set and the areas of the head traversed by the signals can thus be obtained.

According to a preferred aspect, the markers each have a marker body, which is produced from the same material as the nosebracket, the headbracket and/or the sensor caps.

Preferably, the marker body, the nosebracket, the headbracket and the sensor caps can be produced from the same material.

The markers or their bodies can be better distinguished from the set in an MRI scan by the material in the marker body. The positioning of the set or of the sensors can thus be determined three-dimensionally on the head.

5 According to a preferred aspect, the set further comprises at least one preferably approximately disc-shaped pad, which can be fastened to one of the sensor caps and/or the headbracket and has a hole, so that, when the pad is fastened to the sensor cap and/or the headbracket, the hole is aligned with the opening of the sensor cap in such a way that a sensor arranged in the recess of the sensor cap bears against the head or the scalp via or through the opening and via or through the hole. The edge of the hole of the
10 pad can completely enclose or extend around the opening of the sensor cap, for example, the outer diameter of the opening can be smaller than the inner diameter of the hole. The hole and/or opening can be circular. Preferably, the pad can be releasably fastened to one of the sensor caps and/or the headbracket, for example by means of an adhesive. Preferably, the pad is designed to adhere to the scalp, for example by means of an
15 adhesive.

Such a pad is configured, according to the application, to rest between the head and the sensor cap. A sensor arranged in the recess of the sensor cap is exposed through the hole in the pad. The pad can, for example, be adhesively bonded to the sensor cap and/or the sensor bracket.

20 The adhesion of the sensor cap to the head is improved by such a pad. This reduces the risk of a change in position of the set on the head. The pad preferably has a relatively high coefficient of friction with respect to the head, in particular the scalp. Furthermore, the pad can be designed elastically, so that it is compressed by exerting force from the sides of the head and from the sides of the sensor cap and the sensor can rest against an area
25 of the head. Such a pad can, for example, be produced from silicone.

According to a preferred aspect, the pad preferably protrudes beyond lateral edges of the sensor cap and has a gap, through which a section of the head or the scalp can be marked when the pad is fastened to the sensor cap and/or the headbracket.

When the set with such a pad rests against the head, a region of the head exposed by the
30 gap can be marked. The markings are also visible after removal of the set from the head,

so that the set can be placed again at the same position on the head on the basis of the markings thus set after removal.

According to a preferred aspect, the headbracket comprises: a curved section, which extends around the axis preferably approximately semicircularly in the first plane; two
5 approximately rectilinearly running sections, which each merge into the curved area at a first end and at the opposite second end of which a sensor cap is located in each case; wherein the two approximately rectilinearly running sections extend towards one another starting from the respective first end.

This aspect ensures that the contact pressure exerted by the headbracket is focused on
10 the sensor caps and the sensors located therein.

According to a preferred aspect, the approximately rectilinearly running sections each enclose an angle of 75° - 85° , 77° - 83° or approximately 80° , with a second plane oriented perpendicular to the first plane through the first ends of the two approximately rectilinearly running sections.

15 The inventors have found that such an angle has the effect that, for a multiplicity of patients, a sufficient contact pressure can be realized while avoiding the headbracket bearing against the head, while the headbracket runs approximately semicircularly between the respective first ends.

According to a preferred aspect, the headbracket is formed elastically, preferably as a
20 bending spring.

The set can be designed, for example, in such a way that a diameter measured between the opposite sensor caps is smaller than a transverse diameter of the head, preferably in an area above the ear canals.

As a result of the elasticity and the associated restoring force of the headbracket, it is
25 ensured that the headbracket presses the sensor caps and the sensors located therein against lateral regions of the head. The set can thus be fixed at least temporarily on the head of a patient.

According to a preferred aspect, the headbracket, the nosebracket and the sensor caps are preferably formed in one piece from the same material. In other preferred aspects,

designs are also possible in which the headbracket, the nosebracket and the sensor caps are formed from different parts and/or different materials and can be fixed with respect to one another.

5 A sufficient rigidity of the set is thus brought about, so that a change in the position of the sensor caps between individual measurements is avoided.

The set is preferably formed in such a way that the relative positions of the sensor caps, the headbracket and the nosebracket cannot be changed between individual measurements. This means that the positions of the sensor caps, the headbracket and the nosebracket are consistent at least between individual measurements. For this
10 purpose, according to a preferred aspect, the sensor caps, the headbracket and the nosebracket are formed in one piece or at least can be fixed with respect to one another.

According to a preferred aspect, the material is a biocompatible material, preferably a polyamide PA12, particularly preferably PA2200.

15 Biocompatible material does not trigger toxicological processes. This material is thus compatible in order to rest on the skin and relatively easily. Such a material is particularly advantageous if the set is placed on the head over a relatively long period of time.

Furthermore, such a material is suitable for MRI measurements on the head with a set placed on the head to be carried out since it has no magnetic or paramagnetic properties.

20 In further aspects, a particularly advantageous sensor cap for positioning sensors on a head is provided.

According to a preferred aspect, a sensor cap for receiving at least one sensor is provided, wherein the sensor cap comprises: a preferably approximately cylindrical recess for receiving a sensor, wherein the recess has an opening on one side and is at least partially delimited by the sensor cap on a bottom side of the sensor cap opposite the opening and
25 on at least one side surface of the sensor cap.

Such a sensor cap is configured to receive a sensor in the recess. A front side of the sensor is exposed through the opening, so that the front side can rest on a head of a patient. The sensor is delimited by the bottom side and the at least one side surface in the recess and held in position.

According to a preferred aspect, the sensor cap has at a preferably approximately central position on the bottom side a preferably approximately hemispherical elevation directed in the direction of the opening.

5 When the sensor lies with the front side on a surface of the head, the sensor can thus adapt its orientation to the surface of the head.

According to a preferred aspect, the sensor cap has a lead-through opening into the recess through the at least one side surface, wherein the lead-through opening opens into the opening of the recess via a lead-through region.

10 If a sensor connected to a sensor cable is inserted into the sensor cap through the opening of the recess, the sensor cable can be inserted into the lead-through opening through the lead-through region at the same time as the sensor is inserted into the recess. The sensor cable is thus advantageously guided away from the sensor in the recess through the sensor cap. Furthermore, the cable is at least partially delimited circumferentially by the sensor cap, as a result of which a mobility of the sensor in the recess is restricted. For
15 example, a rotation about the direction running perpendicular to the front side and the rear side is thus avoided.

According to a preferred aspect, the lead-through region has a taper with respect to a diameter of the lead-through opening.

A sensor cable connected to the sensor is held in the lead-through opening by the taper.
20 A sensor connected to the sensor cable can thus be held in the recess.

According to a preferred aspect, the sensor cap has a further opening, which at least partially exposes the recess through the at least one side surface and/or through the bottom side.

25 The regions of the sensor exposed by the further opening are accessible from outside the sensor cap. As a result, a sensor can be removed more easily from the recess of the sensor cap. In addition, a heat dissipation of the sensor is improved, since these regions are not surrounded by the sensor cap.

According to a preferred aspect, the sensor cap has a further recess with a magnet on a side opposite the opening of the recess.

By positioning a magnet on the side of the sensor cap opposite the opening of the recess, the magnet and the sensor cap are pulled against one another by a magnetic force, so that a force acts on the sensor in the direction of the bottom side and the sensor is held in the recess.

- 5 Furthermore, the object mentioned at the outset is achieved by a method for producing the above-described set or for producing a sensor cap, the method comprising the production of the set or the sensor cap by means of 3D printing.

With such a production method, both the set and the sensor cap can be produced particularly efficiently and on a patient-specific basis. In particular, the set or the sensor
10 caps can be formed in one piece particularly effectively by means of 3D printing.

Furthermore, the object is achieved by a use of the set described at the outset, comprising the steps: inserting in each case at least one sensor into a recess of a sensor cap; positioning the set on the head, so that the sensors in the sensor caps rest on opposite sides on the head and the nosebracket sits on the back of the nose.

- 15 Through the use of such a set, sensors which are arranged in the sensor caps can be placed on the opposite areas of the head for a measurement.

According to a preferred aspect, the insertion of in each case at least one sensor into a recess of a sensor cap comprises: during the insertion of the at least one sensor into the recess of a sensor cap, leading a sensor cable connected to the sensor through the lead-
20 through region into the lead-through opening, in order to latch the cable through the taper.

A sensor can thus be held in the recess of the sensor cap.

According to a preferred aspect, the insertion of in each case at least one sensor into a recess of a sensor cap comprises: inserting the at least one sensor into the recess of a
25 sensor cap until a rear side of the sensor strikes the bottom side or the elevation.

Through the stop on the elevation, the sensor can adapt its orientation under the influence of a pressure exerted on the sensor by the head.

According to the invention, a sensor cap for receiving at least one sensor is likewise provided, the sensor cap comprising: a force sensor according to the invention; a

preferably approximately cylindrical recess for receiving the force sensor, wherein the recess has an opening on one side and is at least partially delimited by the sensor cap on a bottom side of the sensor cap opposite the opening and on at least one side surface of the sensor cap.

- 5 The force sensor according to the invention, the sensor group according to the invention, the assembly according to the invention, the set according to the invention and the sensor cap according to the invention can be used particularly advantageously for detecting a carlottery movement of a skull.

10 A computer-aided method according to the invention for detecting a carlottery movement of a skull of a head by means of a set according to the invention arranged on the head can comprise: detecting an electrical signal generated by means of the electrical variable of at least one of the force sensors; and detecting the carlottery movement based on the detected electrical signal.

15 A further computer-aided method according to the invention for determining a physiological parameter of a patient by means of at least one force sensor according to the invention arranged on a region of a body part, preferably a vein such as an artery, can comprise: detecting an electrical signal generated by means of the electrical variable of the force sensor; and determining the physiological parameter based on the detected electrical signal.

20 A further computer-aided method according to the invention for generating a control signal for a software application by means of a set according to the invention arranged on a body part, preferably a head, can comprise: detecting a pattern in an electrical signal generated by means of the electrical variable of at least one of the force sensors; and in response to the detected pattern, generating a control signal for a function of the software
25 application.

Further properties, features and advantages of the disclosure will become clear below by means of a description of preferred embodiments of the disclosure with reference to the accompanying exemplary drawings, in which:

BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. 1A to C show, by way of example, force sensors according to the invention with differently shaped attachments.

5 FIGS. 2A to B show, by way of example, force sensors according to the invention with attachments placed at different locations relative to the active layer.

FIG. 3A shows, by way of example, a sensor group according to the invention in a set according to the invention, and also a measuring apparatus.

FIGS. 3B to C show, by way of example, the measurement results achieved with the measuring apparatus according to FIG. 3A .

10 FIG. 4 shows, by way of example, an assembly according to the invention comprising a force sensor according to the invention and a further sensor.

FIG. 5A shows, by way of example, a force sensor according to the invention in a measuring apparatus.

15 FIG. 5B shows, by way of example, the measurement results achieved with the measuring apparatus according to FIG. 5A .

FIG. 6 shows, by way of example, a perspective view of a set.

FIG. 7 shows, by way of example, a plan view of a set.

FIG. 8 shows, by way of example, an enlarged illustration of a sensor cap.

FIG. 9 shows, by way of example, a perspective view of a set with markers.

20 The features disclosed in the above description, the figures and the claims may be significant both individually and in any combination for the realization of the disclosure in the different configurations.

Reference signs in the figures each refer to the same elements.

DETAILED DESCRIPTION

25 FIGS. 1 and 2 show, by way of example, preferred realizations of the force sensor 1000 according to the invention.

As can be seen from the figures, the force sensor 1000 comprises an active layer 1001, wherein an electrical variable of the force sensor 1000 depends on a force F acting on the active layer 1001 in such a way that a change in the electrical variable is caused by a change in the force acting on the active layer 1001 . The force sensor 1000 further comprises an attachment 1002 which is arranged relative to the active layer 1001 in such a way that a force acting on the force sensor 1000 from the outside is conducted onto the active layer 1001 by means of the attachment 1002 (e.g. through the attachment). The attachment thus contributes to the force F acting on the force sensor 1000 reaching the active layer 1001 .

The active layer 1001 can have an active surface 1001a, wherein the electrical variable of the force sensor can depend on the force F acting on the active surface 1001a in such a way that the change in the electrical variable is caused by a change in the force acting on the active surface.

The force sensor 1000 preferably has a first side surface 1002b which faces the active layer 1001 and/or the active surface 1001a of the active layer 1001 . Preferably, the attachment 1002 can rest with the first side surface 1002b on the active layer 1001 or on the active surface 1001a of the active layer 1001 . The attachment 1002 can have a second side surface 1002a which faces away from the active layer 1001 and/or the active surface 1001a of the active layer 1001 . As illustrated in FIGS. 1A to C, the force F to be detected can act on the attachment 1002 via the second side surface 1002a, wherein this force is introduced via the first side surface 1002b onto the active layer 1001 or the active surface 1001a thereof and causes a change in the electrical variable there.

As illustrated in FIGS. 1B and 1C, a first cross section through the attachment 1002 can have a larger cross-sectional area than a second cross section through the attachment, wherein the second cross section is further away from the active layer 1001 and/or the active surface of the active layer 1001 than the first cross section. The attachment 1002 can alternatively or additionally taper in a direction away from the active layer 1001 and/or the active surface of the active layer 1001 .

The attachment 1002 can be cuboidal (FIG. 1A), frustoconical or prismatic (FIG. 1B), or hemispherical (FIG. 1C).

The attachment can be mounted, directly or indirectly, on the active layer 1001 .

The force sensor 1000 can be designed in such a way that, in the event of an increase in the force acting on the active layer 1001 (or active surface 1001a), the electrical variable (e.g. electrical resistance or electrical voltage) drops, preferably continuously and/or proportionally; and/or the force sensor 1000 can be designed in such a way that, in the event of a reduction in the force acting on the active layer 1001 (or active surface 1001a), the electrical variable rises, preferably continuously and/or proportionally. For example, the force sensor can be a transimpedance converter, such as, for example, the Force Sensing Resistor (FSR) from Interlink Electronics. The force sensor 1000 of the type described herein allows a high-ohmic resistance to be provided in the unloaded state, allows exponential changes in the electrical variable (e.g. resistance), has no cross-sensitivity, and allows an improved introduction of the force onto the sensor (e.g. force focusing) to be achieved without a complicated mechanical construction.

The force sensor 1000 can be designed in such a way that, in an unloaded state of the active layer 1001, an electrical contact of the force sensor 1000 is interrupted, and in such a way that the electrical contact is closed by the force acting on the active layer 1001 in order to make the change in the electrical variable measurable as a function of the change in the force F acting on the active layer 1001 (or active surface 1001a).

FIG. 2 shows, by way of example, a preferred internal construction of the force sensor 1000 according to the invention, in particular of the active layer 1001 .

The active layer 1001 of the force sensor 1000 can comprise a first substrate 1004 and a second substrate 1006 which, in the unloaded state of the active layer 1001, are spaced apart from one another (e.g. by a spacer 1005 arranged in between, such as an adhesive layer) and thereby interrupt the electrical contact. The two substrates 1004, 1006 can be arranged in such a way that the substrates 1004, 1006 come into contact with one another by the force F acting on the active layer 1001 and thereby close the electrical contact. Preferably, the force acting on the active layer 1001 can act on the active surface 1001a of the active layer 1001, wherein the active surface 1001a can be a surface of the first substrate 1004 (as shown by way of example in FIG. 2) or of the second substrate 1006 .

The attachment can rest on a surface (e.g. the active surface 1001a) of the active layer 1001 . This surface can be, for example, on a front side or a rear side of the active layer. For example, the attachment can rest on the surface (e.g. the active surface 1001a) of the

first substrate 1004 or on the surface (e.g. the rear side of the active layer) of the second substrate 1006 . The attachment can preferably be releasably fastened to the force sensor or to the active layer 1001 by a fastening means (e.g. a film or an adhesive such as an adhesive film).

- 5 The attachment 1002 can be designed to focus the force F acting on the force sensor 1000 from the outside onto the active layer 1001 and/or the active surface 1001a of the active layer 1001 .

The force sensor 1000 can optionally further comprise a carrier 1003, such as a wafer, for carrying the active layer 1001 and the attachment 1002, as illustrated in FIG. 2 . The carrier, especially wafer, comprises electrodes for picking up an electrical variable (e.g. a voltage) which depends on the force F . The wafer is to be understood as a substrate (e.g. plate or layer) for electronic components and the wafer can be manufactured from different materials, such as semiconductor, plastic or glass. Other types of carriers are likewise possible.

- 15 Preferably, the active layer 1001 is arranged between the attachment 1002 and the carrier, especially wafer, 1003 (FIG. 2 A). The attachment 1002 is then arranged on the front side of the active layer 1001 . In this way, the force F to be detected can act on the active layer 1001 or the active area 1001a thereof from the outside by means of the attachment 1002 (here: through the attachment). Preferably, the second substrate 1006 can be arranged between the first substrate 1004 and the carrier, especially wafer, 1003 and the first substrate 1004 can be arranged between the attachment 1002 and the second substrate 1006 .

Alternatively or additionally, the/an attachment 1002 can be arranged between the active layer 1001, in particular the second substrate 1006, and the carrier, especially wafer, 1003 on the rear side of the active layer 1001 (FIG. 2 B). In this case, a force acting on the force sensor from the outside, in particular outside the active area 1001a, can nevertheless reach the active layer by way of a counterforce, which is then brought about by the attachment 1002 on the rear side of the active layer 1001, and there preferably bring about an electrical contact between the two substrates 1004 and 1006 . For example, electrical contacts which are higher than the active area can also be present on the substrate 1006 . The attachment 1002 then compensates for this difference in height. In the manner illustrated in FIG. 2B of the arrangement of the attachment 1002, a force

acting on the force sensor from the outside can also act on the active layer 1001 or the active area 10001a thereof by means of the attachment.

The carrier, especially wafer, 10003 and/or the attachment 1002 act in a stabilizing manner for the force sensor and in particular for the substrates 1004 to 1006 thereof.

5 For example, the upper substrate 1005 and/or lower substrate 1006 of the force sensor can be flexible (e.g. a film 1005, 1006), as a result of which the force sensor can curve. The carrier, especially wafer, and/or the attachment prevent such a curvature in both arrangements according to FIGS. 2A and 2B .

10 For the arrangements according to FIGS. 2A and B, the attachment 1002 is preferably made of a rigid material.

FIG. 2 illustrates, by way of example, the cuboidal shape of the attachment 1002 from FIG. 1A . However, all of the features of the force sensor described in connection with FIG. 2 can also be realized with an attachment 1002 which has a different one of the shapes described herein, for example the shape according to one of FIGS. 1B or 1C .

15 FIG. 3A shows, by way of example, a sensor group 1000-1, 1000-2 according to the invention in a set 1 according to the invention, and also a measuring apparatus. FIGS. 3B to C show, by way of example, the measurement results achieved with the measuring apparatus according to FIG. 3A .

20 FIG. 3A shows, by way of example, the use of a set according to the invention with a sensor group in a measuring apparatus. The sensor group comprises: a first force sensor 1000-1 according to the invention and a second force sensor 1000-2 according to the invention. Preferably, the first force sensor 1000-1 and the second force sensor 1000-2 are electrically connected in parallel with one another in order to increase the sensitivity thereof. The electrical resistance of the first force sensor 1000-1 can be electrically
25 connected in parallel with an electrical resistance of the second force sensor 1000-2.

The sensors 1000-1, 1000-2 are each fixed on opposite sides of a head 1040 of a patient by means of the set 1 according to the invention, which is described further below in FIGS. 6 to 9 (see FIG. 3A). The set performs the following tasks: fixing the force sensors on the measuring points T 3 and T 4 of the head and generating a contact pressure so
30 that the force sensors are subjected to a preload.

The force sensors are used here for detecting the movement or extension of the calottes. Since the calotte moves rhythmically synchronously with the blood flow, this movement can thus be qualitatively detected. FIG. 3A schematically shows the extension ΔS of the calotte, wherein the extension can be most pronounced at the measuring points T 3 and T 4 of the head.

As a result of the extension ΔS , a force ΔF acts on the force sensors 1000-1, 1000-2. Each sensor 1000-1, 1000-2 changes its resistance R proportionally to the force ΔF , said resistance being converted by means of an electronic circuit into a voltage which is amplified (circuit and/or transimpedance amplifier 1010). The output of this amplifier 1010 represents a voltage U which has been digitized in converter 1020 (e.g. XTDC) and subsequently visualized and/or evaluated at a data processing unit 1030. FIG. 3B shows an exemplary profile of the voltage U over time t and its normalized frequency spectrum. The dominant frequency corresponds to 1 Hz, which corresponds to a heartbeat of 60 beats per minute.

If an individual pulse from the voltage profile in FIG. 3B is considered in FIG. 3C, the profile of the carlottery movement can be qualitatively tracked from the voltage change. The electrical resistance R of the force sensor sings with rising force F , which is caused by the carlottery movement and acts on the force sensor, and, depending on the predetermined circuit, this is accompanied by a corresponding drop or rise in the voltage U which is detected. Conversely, the electrical resistance R of the force sensor rises as a result of the force F , which falls with the carlottery movement and acts on the force sensor, and, depending on the predetermined circuit, this is accompanied by a corresponding rise or drop in the voltage U which is detected.

Correspondingly, a computer-aided method for detecting a carlottery movement of a skull of a head by means of a set 1 according to the invention arranged on the head can comprise the following operations: detecting an electrical signal generated by means of the electrical variable of at least one of the force sensors 1000-1, 1000-2; and detecting the carlottery movement based on the detected electrical signal.

FIG. 4 shows an assembly according to the invention. The assembly 100 comprises: a force sensor 1000 according to the invention; a further sensor 102, which is designed to emit and/or to receive a signal via an active sensor surface 101 of the further sensor 102; wherein the force sensor 1000 is mounted on a side surface, preferably opposite the

active sensor surface 101, of the further sensor 102 in such a way that the attachment 1002, in particular the second side surface 1002a thereof, faces away from the side surface of the further sensor 102 .

The further sensor 102 can be a transmitter and/or a receiver of the signal. Preferably, the further sensor 102 is an ultrasound probe, wherein the signal is an ultrasound signal. This assembly 100 can be installed in the set or the sensor caps thereof instead of the two force sensors 1000-1, 1002 in FIG. 3, in order to carry out the qualitative tracking of the carlottery movement in FIGS. 3B and 3C in parallel and substantially at the same location as the ultrasound measurements carried out by the head of the patient, in order to qualitatively take into account the carlottery movement in the evaluation of the ultrasound measurement, in order to make said measurement more meaningful.

FIG. 5A shows a measurement setup with at least one force sensor 1000 according to the invention, which is placed on a region 1050 of a body part of a patient, in order to detect a force ΔF there. This region 1050 can be a vein or a muscle or else another region of the body part. The force sensor 1000 can, for example, be integrated in an arm band, chest strap, collar, head band or the set according to the invention. The sensor can also be held manually on the region 1050 .

The sensor 1000 changes its resistance R proportionally to the force ΔF , said resistance being converted by means of an electronic circuit into a voltage which is amplified (circuit and/or transimpedance amplifier 1010). The output of this amplifier 1010 represents a voltage U which has been digitized in converter 1020 (e.g. XTDC) and subsequently visualized and/or evaluated at a data processing unit 1030.

FIG. 5B shows an exemplary profile of the voltage U over time t and its normalized frequency spectrum. FIG. 5B shows measurement results in which the force sensor according to the invention was held on an artery (A. carotid) and the data recording of the voltage U was carried out in each case, wherein periodic force changes were qualitatively detected here as well. The dominant frequency in the frequency spectrum of FIG. 5B corresponds to 1 Hz, which corresponds to a heartbeat of 60 beats per minute.

Correspondingly, a computer-aided method according to the invention for determining a physiological parameter of a patient by means of at least one force sensor 1000 arranged on a region 1050 of a body part, preferably a vein such as an artery, can

comprise the following operation: detecting an electrical signal generated by means of the electrical variable of the force sensor 1000; and determining the physiological parameter based on the detected electrical signal.

Preferably, the force sensor 1000 can be arranged on the region 1050 in such a way that a force caused by the region 1050 (e.g. the vein) acts on the active layer 1001 of the at least one force sensor 1000 via the attachment 1002 .

The reliable detection of forces or changes of forces in the region of the human body can be used for diverse uses, in particular in the field of patient care. Thus, for example, the force sensor 1000 according to the invention can be placed on a patient or a muscle in the region of the head, in order to thus, for example, detect the compression of the teeth. From these detected forces or changes of the forces on account of the muscle activity during the compression of the teeth, specific signal patterns can be generated in control signals in order to actuate a function in a software application. Such a function can be actuated the switching on, switching off, starting of a communication, ending of a communication, or another function of a software application from the everyday life of a patient. It is thus made possible for patients, in particular paralysed or otherwise disabled people, to be able to participate in the everyday life, even if, for example, arms and/or legs cannot be moved. Thus, solely on account of muscle activity, for example on the head, the patient can emit signals for his surroundings and carry out a control.

Correspondingly, a computer-aided method according to the invention for generating a control signal for a software application by means of one or more force sensors 1000, 1000-1, 1000-2 according to the invention or a set 1 according to the invention arranged on a body part, such as the head, can comprise the following operations: detecting a pattern in an electrical signal generated by means of the electrical variable of at least one of the force sensors 1000, 1000-1, 1000-2; and in response to the detected pattern, generating a control signal for a function of the software application. Preferably, different detected patterns can correspond to control signals of different functions of the software application. At least one of the force sensors 1000-1, 1000-2 can preferably be arranged on the head, preferably by means of the set 1, in such a way that a force caused by a movement of a muscle on the head acts on the active layer 1001 of the at least one force sensor 1000-1, 1000-2 via the attachment 1002 .

The method can further comprise: converting the electrical variable of the at least one force sensor 1000-1, 1000-2 into the electrical signal by means of an electrical circuit 1010, preferably wherein the electrical variable is an electrical resistance and the electrical signal is an electrical voltage signal. Preferably, the electrical signal can be converted at a digital converter 1020 into a digital signal which is evaluated and/or visualized at a data processing unit 1030 .

FIG. 6 shows, by way of example, a configuration of a set 1 according to the invention together with one or more force sensors 1000 according to the invention (not shown here). The set 1 serves for positioning the one or more force sensors 1000, and possibly a further sensor 102 each (e.g. assembly 100), on opposite areas of a head, as can also be used in FIG. 3 A, 4 or 5 A, in order to position the one or more sensors 102, 1000 on the head.

The set 1 comprises a headbracket 2 which at least partially extends around an axis A in a first plane running perpendicular to the axis A. Two sensor caps 3 for receiving at least one sensor 102 and/or 1000 each, e.g. the assembly 100, are located at opposite ends of the headbracket 2 . The sensor cap 3 can receive an assembly 100, e.g. an assembly 100 as shown in FIG. 4 . The active sensor surface 101 of the further sensor 102 can lie on the surface of the head while the attachment 1002 of the force sensor 1000 lies on the bottom side 8 or the elevation 10 of the set 1 (cf. FIG. 8). Thus, the measurement with the further sensor 102 on the head can be carried out particularly effectively while the force sensor 1000 detects a force acting on the active layer 1001 on the part of the set 1 via the attachment 1002 .

Further, the set 1 comprises a nosebracket 4 which, starting from an approximately central area between the sensor caps 3, extends in a direction approximately perpendicular to the headbracket 2 . The nosebracket 4 has a preferably bracket-shaped end piece 5 at an end opposite the headbracket 2 for receiving the back of the nose of a head.

The headbracket 2 is dimensioned such that the sensor caps 3 are positioned on the head on opposite areas of the head, preferably in an area between the T3 and the T5 position in the 10-20 system and in an area between the T4 and the T6 position in the 10-20 system, when the headbracket 2 at least partially extends around the head and the nosebracket 4 with the end piece 5 is supported on the back of the nose.

According to a preferred aspect, a distance between the sensor caps 3 is smaller than a transverse diameter of the head, preferably measured between the area between the T3 and T5 position and the area between the T4 and the T6 position in the 10-20 system.

5 Further, the headbracket 1 is formed elastically, preferably in one piece, so that the sensor caps 3 with sensors 102, 1000 located therein are pressed laterally on the opposite areas of the head.

10 The sensor caps 3 can each comprise a container and are configured to each receive an approximately cylindrical sensor 102, 1000 or cylindrical assembly 100 . For receiving such a sensor 102, 1000, a sensor cap 3 has an interior space 6, preferably a recess 6, which opens into an opening 7 in the direction of the head and is delimited by the sensor cap 3 on a side surface 9 of the sensor cap 3 or the container thereof at least partially extending around the interior space or the recess and is delimited by the sensor cap 3 on a bottom side 8 of the sensor cap 3 or the container opposite the opening 7 .

15 The opening 7 is configured such that a sensor 102, 1000 can be inserted through it into the interior space or the recess 6 . A sensor 102, 1000 arranged in the interior space or the recess 6 is then exposed through the circumferential opening 7 in the direction of the head, so that a front side of the sensor 102, 1000 can rest on the head, wherein the sensor 102, 1000 is delimited laterally by the side surface 9 of the sensor cap 3 and the bottom side 8 of the sensor cap 3 . The sensor 102, 1000 is thus held in the sensor cap 3 when
20 the set 1 rests on the head.

The openings 7 of the two sensor caps 3 face one another in the example shown. The sensors 102, 1000 arranged in the recesses 6 can thus be aligned with one another.

25 Furthermore, a sensor cap 3 has at least one, preferably two, lead-through openings 11 through the side surface of the sensor cap 3 for a sensor cable connected to the sensor. A lead-through opening is configured to guide a sensor cable connected to the sensor laterally out of the sensor cap through the sensor cap.

The two lead-through openings 12 can be spaced apart from one another in the circumferential direction. Different radial orientations of the sensors 102, 1000 in the interior space or the recess 6 are thus possible.

A lead-through opening 11 opens into the opening 7 of the sensor cap 3 via a lead-through region 12. The lead-through region 12 and the lead-through opening 11 are configured such that a sensor cable connected to the sensor 102, 1000 can be pushed, starting from the opening 7, through the lead-through region 12 into the lead-through opening 11 when the sensor 102, 1000 is pushed into the interior space or the recess 6 via the opening 7. The sensor cable connected to the sensor is thus guided laterally away from the sensor 102, 1000 through the sensor cap 3.

In this case, the sensor cable is at least partially delimited circumferentially by the sensor cap 3, as a result of which the sensor 102, 1000 is held in position.

The lead-through opening 11 has a taper 13 with respect to a diameter of the lead-through opening 11, so that a sensor cable cannot slide directly through the lead-through region 12 out of the lead-through opening 11 in the direction of the opening 7. A sensor 102, 1000 connected to the sensor cable can thus be fixed in the interior space or the recess 6.

Furthermore, a sensor cap 3 has a further opening 14, which at least partially exposes the interior space or the recess 6 through the side surface 9 of the sensor cap 3 and the bottom side 8 of the sensor cap 3. A sensor 102, 1000 arranged in the interior space or the recess 6 is thus at least partially exposed.

FIG. 7 shows a plan view of the set 1 in FIG. 6.

The headbracket 2 has a curved section 16, which extends around the axis A at least partially in the first plane. The curved section 16 is preferably formed semicircularly. Furthermore, the headbracket 2 has two approximately rectilinearly running sections 17, which run in the first plane. The two approximately rectilinearly running sections 17 each merge into the curved section 16 at a first end and each open into a sensor cap 3 at a second end opposite the first end.

It can be seen in the plan view that the two approximately rectilinearly running sections 17 extend towards one another starting from the respective first end in the first plane.

It can be seen on the basis of the plan view that a distance measured between the sensor caps 3 is smaller than a radial diameter of the curved area 16 measured between the first ends of the respective approximately rectilinearly running sections 17.

The contact pressure exerted on the head is thus focused on the sensor caps 3 or on the sensors 102, 1000 in the sensor caps 3 .

FIG. 8 shows a perspective view of a sensor cap 3 of the set 1 shown in FIG. 6 or FIG. 7 .

5 It is shown that the sensor cap 3 has an approximately cylindrical recess 6, which is delimited on one side by a circumferential opening 7 and is delimited on a side opposite the opening 7 by a bottom side 8 of the sensor cap 3 and laterally by a circumferential side surface 9 of the sensor cap 3 . The recess 6 (or interior space) thus formed in the sensor cap 3 serves for receiving a sensor 102, 1000 .

10 Furthermore, the sensor cap 3 has on the bottom side 8 an approximately hemispherical elevation 10 directed in the direction of the opening, which forms a stop for a sensor 102, 1000 .

15 If a sensor 102, 1000 strikes the approximately hemispherical elevation 10 with a rear side in a first region, a region of the rear side of the sensor extending around the first region is spaced apart from the bottom side 8 of the sensor cap 3 . When a pressure force is exerted on the sensor 102, 1000 by the head in the direction of the bottom side, the sensor 102, 1000 can thus adapt its orientation within the recess 6 .

Furthermore, the lead-through openings 11 are visible through the side surface 9 of the sensor cap 3, which open into the opening 7 via the lead-through region 12 .

20 The lead-through region 12 has a taper 13 . The taper 13 is formed by opposite areas of the sensor cap 3, which have a distance from one another which is smaller than a diameter of the lead-through opening 11 .

25 To form a taper, the opposite lateral regions of the sensor cap can have a bevel in the direction of the opening 7, so that the sensor cable can be guided more easily from the opening 7 in the direction of the lead-through opening 12 into the lead-through opening 12 when inserted into the lead-through opening 11 through the lead-through region 12 .

Furthermore, a further recess 14 of the sensor cap 3 can be recognized, which at least partially exposes the interior space or the recess 6 through the bottom side 8 of the sensor cap 3 and the side surface 9 of the sensor cap 3 .

FIG. 9 shows a perspective view of a set 1 in combination with markers 15 .

The markers 15 are formed approximately clip-shaped and can be fastened to the set 1 in different areas. The markers 15 are preferably formed from the same material as the set 1 .

5 In some examples, a marker 15 can be fastened to an approximately central area of the nosebracket 4 and at least two further markers 15 can be fastened to different areas of the headbracket 2 . In further examples, the at least two markers 15 can each be fastened to a side of a sensor cap 3 facing away from the head. In further examples, a plurality of markers 15 can be fastened to different areas of the set 1 on the sensor caps 3, on the headbracket 2 and on the nosebracket 4 .

10 The markers 15 are visible in particular in an MRI scan of the head with the set 1 placed thereon, so that the position of the set 1 and in relation to information about the head can be set in the MRI scan.

The disclosure described herein can be defined (alternatively) by the following numbered aspects:

Numbered Aspects

- 5 1. A force sensor (1000), comprising:
an active layer (1001), wherein an electrical variable of the force sensor (1000)
depends on a force acting on the active layer (1001) in such a way that a change
in the electrical variable is caused by a change in the force acting on the active
layer (1001);
10 characterized in that
the force sensor (1000) comprises an attachment (1002) which is arranged
relative to the active layer (1001) in such a way that a force acting on the force
sensor (1000) from the outside is conducted onto the active layer (1001) by means
of the attachment (1002).
15
2. The force sensor (1000) according to aspect 1, wherein the force sensor (1000) is
designed in such a way that, in the event of an increase in the force acting on the
active layer (1001), the electrical variable drops, preferably continuously and/or
proportionally; and/or
20 wherein the force sensor (1000) is designed in such a way that, in the event of a
reduction in the force acting on the active layer (1001), the electrical variable
rises, preferably continuously and/or proportionally.
- 25 3. The force sensor (1000) according to one of the preceding aspects, wherein the
force sensor (1000) is designed in such a way that, in an unloaded state of the
active layer (1001), an electrical contact of the force sensor (1000) is interrupted,
and in such a way that the electrical contact is closed by the force acting on the
active layer (1001) in order to make the change in the electrical variable
measurable as a function of the change in the force acting on the active layer
30 (1001).
4. The force sensor (1000) according to aspect 3, wherein the active layer (1001)
comprises a first substrate (1004) and a second substrate (1006) which, in the

unloaded state of the active layer (1001), are spaced apart from one another and thereby interrupt the electrical contact, wherein the two substrates (1004, 1006) are arranged in such a way that the substrates (1004, 1006) come into contact with one another by the force acting on the active layer (1001) and thereby close the electrical contact.

5. The force sensor (1000) according to aspect 4, wherein the force acting on the active layer (1001) acts on an active surface (1001a) of the active layer (1001), wherein the active surface (1001a) is a surface of the first substrate (1004) or of the second substrate (1006).
6. The force sensor (1000) according to one of the preceding aspects, wherein the attachment (1002) is designed to focus the force acting on the force sensor (1000) from the outside onto the active layer (1001) and/or the active surface (1001a) of the active layer (1001).
7. The force sensor (1000) according to one of the preceding aspects, wherein the attachment (1002) has a first side surface (1002b) which faces the active layer (1001) and/or the active surface of the active layer (1001), and wherein the attachment (1002) has a second side surface (1002a) which faces away from the active layer (1001) and/or the active surface of the active layer (1001).
8. The force sensor (1000) according to aspect 8, wherein the attachment (1002) is designed to direct the force acting on the force sensor (1000) from the outside onto the active layer (1001) and/or the active surface (1001a) of the active layer (1001) via the second side surface (1002a), through the attachment (1002) and via the first side surface (1002b).
9. The force sensor (1000) according to one of the preceding aspects, wherein a first cross section through the attachment (1002) has a larger cross-sectional area than a second cross section through the attachment, wherein the second cross section is further away from the active layer (1001) and/or the active surface of the active layer (1001) than the first cross section.

10. The force sensor (1000) according to one of the preceding aspects, wherein the attachment (1002) tapers in a direction away from the active layer (1001) and/or the active surface of the active layer (1001).
- 5 11. The force sensor (1000) according to one of the preceding aspects, wherein the attachment (1002) is cuboidal, frustoconical, hemispherical or prismatic.
12. The force sensor (1000) according to one of the preceding aspects, wherein the attachment is mounted, preferably directly, on the active layer (1001).
- 10 13. The force sensor (1000) according to one of the preceding aspects, further comprising a wafer (1003) for carrying the active layer (1001) and the attachment (1002).
- 15 14. The force sensor (1000) according to aspect 13, wherein the attachment (1002) is arranged between the active layer (1001), in particular the second substrate (1006), and the wafer (1003).
- 20 15. The force sensor (1000) according to aspect 13, wherein the active layer (1001) is arranged between the attachment (1002) and the wafer (1003), preferably wherein the second substrate (1006) is arranged between the first substrate (1004) and the wafer (1003) and the first substrate (1004) is arranged between the attachment (1002) and the second substrate (1006).
- 25 16. The force sensor (1000) according to one of the preceding aspects, wherein the attachment (1002) is made of a rigid material.
- 30 17. A sensor group, comprising: a first force sensor (1000-1) according to one of the preceding aspects and a second force sensor (1000-2) according to one of the preceding aspects, wherein the first force sensor (1000-1) and the second force sensor (1000-2) are electrically connected in parallel with one another.
18. The sensor group according to aspect 17, wherein the first force sensor (1000-1) and the second force sensor (1000-2) are electrically connected in parallel with

one another in such a way that the sensitivity for a detection of a force acting on the active layers (1001) of the force sensors (1000-1, 1000-2) is higher than the sensitivity with which one of the force sensors (1000-1, 1000-2) detects a force acting on the active layer (1001) of the one force sensor.

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19. The sensor group according to aspect 17 or 18, wherein an electrical resistance of the first force sensor (1000-1) is electrically connected in parallel with an electrical resistance of the second force sensor (1000-2).

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20. An assembly (100), comprising:

a force sensor (1000) according to one of the preceding aspects 1 to 16;

a further sensor (102), which is designed to emit and/or to receive a signal via an active sensor surface (101) of the further sensor (102);

wherein the force sensor (1000) is mounted on a side surface, preferably opposite the active sensor surface (101), of the further sensor (102) in such a way that the attachment (1002), in particular the second side surface (1002a) thereof, faces away from the side surface of the further sensor (102).

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21. The assembly (100) according to aspect 20, wherein the further sensor (102) is an ultrasound probe, and wherein the signal is an ultrasound signal.

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22. A set (1) for positioning sensors on opposite areas of a head, the set (1) comprising:

- one or more, preferably two, force sensors (1000, 1000-1, 1000-2) each according to one of the preceding aspects 1-16;

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- a headbracket (2), which is configured to at least partially extend around the head;

- sensor caps (3) arranged on opposite areas of the headbracket (2), which are configured to receive at least one of the force sensors (1000-1, 1000-2) in each case; and

30

- a nosebracket (4) connected to the headbracket (2), which is configured to support the headbracket (2) on a back of the nose of the head.

23. The set according to aspect 22, wherein each of the force sensors is received in another of the sensor caps arranged on opposite areas of the headbracket in such a way that a force caused by the head on the force sensor (1000) acts on the active layer (1001) of the force sensor via the attachment (1002).

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24. The set according to aspect 22 or 23, wherein the set comprises a first assembly (100), which includes the first of the force sensors (1000-1), wherein the set comprises a second assembly (100), which includes a second of the force sensors (1000-2), and wherein each of the two assemblies (100) comprises a further sensor (102), which is configured to emit a signal via an active sensor surface (101) of the further sensor (102) in the direction of the head and/or to receive the signal from the direction of the head and wherein in each of the assemblies (100) the respective force sensor (1000) is mounted on a side surface, preferably opposite the active sensor surface (101), of the respective further sensor (102) in such a way that the attachment (1002) of the respective force sensor (1000-1, 1002-2), in particular the second side surface (1002a) thereof, faces away from the side surface of the respective further sensor (102).

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25. The set according to aspect 24, wherein the sensor caps (3) arranged on opposite areas of the headbracket (2) are configured to receive at least one of the assemblies (100) together with the respective further sensor (102) thereof in each case.

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26. The set according to aspect 24 or 25, wherein in each of the assemblies (100) the further sensor (102) is an ultrasound probe and the signal is an ultrasound signal.

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27. The set according to one of the preceding aspects 22 to 26, wherein the force sensors (1000-1, 1000-2) are electrically connected in parallel with one another and/or wherein the electrical resistances of the force sensors (1000-1, 1000-2) are electrically connected in parallel.

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28. The set according to one of the preceding aspects 22 to 27, wherein the nosebracket (4) is connected to the headbracket (2) in an area of the headbracket (2) approximately centrally between the sensor caps (3).

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29. The set according to one of the preceding aspects 22 to 28, wherein the headbracket (2) at least partially extends around an axis (A) in a first plane running perpendicular to the axis (A), and wherein the nosebracket (4) intersects the first plane, preferably in a direction approximately perpendicular to the first plane.
30. The set (1) according to one of the preceding aspects 22 to 29, wherein the nosebracket (4) has an end piece (5) at an end opposite the headbracket (2), wherein the end piece (5) has a preferably approximately bracket-shaped indentation aligned approximately along the axis (A), which is configured to prevent a relative movement from the nosebracket (4) to the back of the nose in a direction parallel to a frontal plane of the head and parallel to the first plane.
31. The set (1) according to one of the preceding aspects 22 to 30, wherein the nosebracket (4), starting from the connection to the headbracket (2), has a length of 2 cm - 7 cm, preferably approximately 5 cm or less.
32. The set (1) according to one of the preceding aspects 22 to 31, wherein the sensor caps (3) have a distance of 10 cm - 17 cm, preferably 11 cm - 16 cm, from the nosebracket (4).
33. The set (1) according to one of the preceding aspects 22 to 32, wherein each of the sensor caps (3) comprises a preferably approximately cylindrical recess (6) for receiving one of the force sensors (1000-1, 1000-2) and/or one of the further sensors (102), which has an opening (7) on one side and is at least partially delimited by the sensor cap (3) on a bottom side (8) of the sensor cap (3) opposite the opening and on at least one side surface (9) of the sensor cap (3).
34. The set (1) according to aspect 33, wherein the openings (7) of the sensor caps (3) face one another.
35. The set (1) according to one of the aspects 33 or 34, wherein the sensor cap (3) has at a preferably approximately central position on the bottom side (8) a preferably approximately hemispherical elevation (10) directed in the direction

of the opening (7), which represents a stop and/or adjustment aid for a sensor (102, 1000).

5 36. The set (1) according to one of the aspects 33-35, wherein in each case one sensor cap (3) has at least one lead-through opening (11) into the recess (6) through the at least one side surface (9), wherein the lead-through opening (11) opens into the opening (7) of the recess (6) via a lead-through region (12).

10 37. The set (1) according to aspect 36, wherein the lead-through region (12) has a tapering (13) with respect to a diameter of the lead-through opening (11).

15 38. The set (1) according to one of the aspects 22-37, wherein in each case one sensor cap (3) has a further opening (14), which at least partially exposes the recess (6) through the at least one side surface (9) and/or through the bottom side (8).

39. The set (1) according to one of the aspects 33-38, wherein in each case one sensor cap (3) has a further recess for receiving a magnet on a side opposite the opening (7) of the recess (6).

20 40. The set (1) according to one of the preceding aspects 22 to 39, further comprising a magnet, which can be fastened to one of the sensor caps (3), preferably can be fastened in the further recess (6).

25 41. The set (1) according to one of the preceding aspects 22 to 40, wherein the set (1) has at least three preferably clip-shaped markers (15), which can be fastened to the nosebracket (4), the headbracket (2) and/or the sensor caps (3) in areas different from one another.

30 42. The set (1) according to aspect 41, wherein the markers (15) each have a marker body, which is produced from the same material as the nosebracket (4), the headbracket (2) and/or the sensor caps (3).

43. The set (1) according to one of the preceding aspects 33 to 42, further comprising at least one preferably approximately disc-shaped pad, which can be fastened to

one of the sensor caps (3) and/or the headbracket (2) and has a hole, so that, when the pad is fastened to the sensor cap (3) and/or the headbracket (2), the hole is aligned with the opening (7) of the sensor cap (3) in such a way that a sensor arranged in the recess (6) of the sensor cap (3) bears against the scalp via the opening (7) and via the hole.

44. The set according to aspect 43, wherein the pad preferably protrudes beyond lateral edges of the sensor cap (3) and has a gap, through which a section of the head can be marked when the pad is fastened to the sensor cap (3) and/or the headbracket (2).

45. The set (1) according to one of the preceding aspects 33 to 44, wherein the headbracket (2) comprises:

- a curved section (16), which extends around the axis (A) preferably approximately semicircularly in the first plane,
- two approximately rectilinearly running sections (17), which each merge into the curved area (16) at a first end and at the opposite second end of which a sensor cap (3) is located in each case, wherein the two approximately rectilinearly running sections (17) extend towards one another starting from the respective first end.

46. The set (1) according to aspect 45, wherein the approximately rectilinearly running sections (17) each enclose an angle of approximately 75° - 85° , preferably approximately 80° , with a second plane oriented perpendicular to the first plane through the first ends of the two approximately rectilinearly running sections (17).

47. The set (1) according to one of the preceding aspects 33 to 46, wherein the headbracket (2) is formed elastically, preferably as a bending spring.

48. The set (1) according to one of the preceding aspects 33 to 47, wherein the headbracket (2), the nosebracket (4) and the sensor caps (3) are preferably formed in one piece from the same material.

5 49. The set (1) according to aspect 48, wherein the material is a biocompatible material, preferably a polyamide PA12, particularly preferably PA2200.

50. Sensor cap (3) for receiving at least one sensor,

10 the sensor cap (3) comprising:

a force sensor (1000) according to one of the preceding aspects 1-16;

15 a preferably approximately cylindrical recess (6) for receiving the force sensor (1000), wherein the recess (6) has an opening (7) on one side and is at least partially delimited by the sensor cap (3) on a bottom side (8) of the sensor cap (3) opposite the opening (7) and on at least one side surface (9) of the sensor cap (3).

20 51. Sensor cap (3) according to aspect 50, wherein the sensor cap comprises an assembly (100) which includes the force sensor (1000), and wherein the assembly (100) comprises a further sensor (102), which is designed to emit and/or to receive a signal via an active sensor surface (101) of the further sensor, and wherein in the assembly (100) the force sensor (1000) is mounted on a side surface, preferably opposite the active sensor surface (101), of the respective
25 further sensor (102) in such a way that the attachment (1002) of the force sensor (1000), in particular the second side surface (1002a) thereof, faces away from the side surface of the further sensor (102).

30 52. Sensor cap (3) according to aspect 51, wherein the recess is designed to receive the assembly (100) together with the further sensor (102) thereof.

53. Sensor cap (3) according to one of the aspects 50 to 52, wherein the sensor cap (3) has at a preferably approximately central position on the bottom side (8) a

preferably approximately hemispherical elevation (10) directed in the direction of the opening (7), which represents a stop for a sensor (102, 1000).

54. Sensor cap (3) according to one of the aspects 50 to 53, wherein the sensor cap (3) has a lead-through opening (11) into the recess (6) through the at least one side surface (9), wherein the lead-through opening (11) opens into the opening (7) of the recess (6) via a lead-through region (12).

55. Sensor cap (3) according to aspect 54, wherein the lead-through region (12) has a tapering (13) with respect to a diameter of the lead-through opening (11).

56. Sensor cap (3) according to one of the aspects 50 to 55, wherein the sensor cap (3) has a further opening (14), which at least partially exposes the recess (6) through the at least one side surface (9) and/or through the bottom side (8).

57. Sensor cap (3) according to one of the aspects 50 to 56, wherein the sensor cap (3) has a further recess with a magnet on a side opposite the opening (7) of the recess (6).

58. The set according to any one of the aspects 33 to 49 or the sensor cap according to any one of the aspects 50 to 57, wherein each force sensor (1000) or each assembly (100) is arranged in one of the sensor caps or in the recess of the sensor cap.

59. Use of a force sensor (1000) according to one of the aspects 1 to 16, a sensor group (1000-1, 1000-2) according to one of the aspects 16-19, an assembly (100) according to one of the aspects 20-21, a set (1) according to one of the aspects 22-49 or 58, or a sensor cap (3) according to one of the aspects 50-58 for detecting a carlottery movement of a skull.

60. Computer-aided method for detecting a carlottery movement of a skull of a head by means of a set (1) according to one of the aspects 22-49 or 58 arranged on the head, the method comprising:

detecting an electrical signal generated by means of the electrical variable of at least one of the force sensors (1000-1, 1000-2); and
detecting the carlottery movement based on the detected electrical signal.

- 5 61. The method according to aspect 60, wherein the electrical signal is a periodic electrical signal and the carlottery movement is detected by means of a change in the amplitude of the periodic electrical signal.
- 10 62. The method according to aspect 60 or 61, wherein the at least one force sensor (1000-1, 1000-2) is arranged on the head by means of the set in such a way that a force caused by the carlottery movement acts on the active layer (1001) of the at least one force sensor via the attachment (1002).
- 15 63. The method according to aspect 62, wherein the electrical signal correlates with the force caused by the carlottery movement in such a way that a change in the force caused by the carlottery movement causes a change in the amplitude of the electrical signal.
- 20 64. Computer-aided method for determining a physiological parameter of a patient by means of at least one force sensor (1000) according to one of the aspects 1-16 arranged on a region (1050) of a body part, preferably a vein such as an artery, of a patient, the method comprising:
- 25 detecting an electrical signal generated by means of the electrical variable of the force sensor (1000); and
determining the physiological parameter based on the detected electrical signal.
- 30 65. The method according to aspect 64, wherein the force sensor (1000) is arranged on the region (1050) in such a way that a force caused by the region (1050) acts on the active layer (1001) of the at least one force sensor (1000) via the attachment (1002).
66. Computer-aided method for generating a control signal for a software application by means of one or more force sensors (1000) according to one of the aspects 1-

16 or a set (1) according to one of the aspects 22-49 or 58 arranged on a body part (1040), preferably a head, the method comprising:

detecting a pattern in an electrical signal generated by means of the electrical variable of at least one of the force sensors (1000-1, 1000-2); and
in response to the detected pattern, generating a control signal for a function of the software application.

67. The method according to aspect 66, wherein different detected patterns correspond to control signals of different functions of the software application.

68. The method according to aspect 66 or 67, wherein at least one of the force sensors (1000-1, 1000-2) is arranged on the body part (1040) preferably by means of the set (1) in such a way that a force caused by a movement of a muscle on the body part (1040) acts on the active layer (1001) of the at least one force sensor (1000-1, 1000-2) via the attachment (1002).

69. The method according to one of the aspects 60-68, further comprising:
converting the electrical variable of the at least one force sensor (1000-1, 1000-2) into the electrical signal by means of an electrical circuit, preferably wherein the electrical variable is an electrical resistance and the electrical signal is an electrical voltage signal.

Features of different aspects or embodiments of the disclosure have been described above by way of example, so that persons skilled in the art can better understand the present disclosure. However, it is clear that other aspects and embodiments than the subject matter of claims described in detail can also be.

The different aspects and embodiments described above can be combined to create yet further embodiments. These and other changes can be made to the embodiments in light of the above detailed description. In general, the terms used in the following claims should not be construed as limiting the claims to the specific aspects and embodiments disclosed in the specification and claims, but as encompassing all possible embodiments together with the full scope of equivalents to which such claims are entitled.

List of Reference Signs:

	1. Set
	2. Headbracket
5	3. Sensor Caps or Sensor Holders
	4. Nosebracket
	5. End Piece
	6. Interior, especially Recess
	7. Opening
10	8. Bottom Side
	9. Side Surface
	10. Elevation
	11. Lead-through Opening
	12. Lead-through Region
15	13. Taper
	14. Further Opening
	15. Marker
	16. Curved Section
	17. Rectilinear Section
20	A Axis
	100 Assembly
	101 Active Sensor Surface
	102 Further Sensor
	1000, 1000-1, 1000-2 Force Sensor
25	1001 Active Layer
	1001a Active Surface
	1002 Attachment
	1002a Second Side Surface

	1002b First Side Surface
	1003 Carrier, especially Wafer
	1004 First Substrate
	1005 Spacer
5	1006 Second Substrate
	1010 Circuit, optionally with amplifier
	1020 Digital Converter
	1030 Data Processing Unit
	1040 Body Part
10	1050 Region of a Body Part

Claims

1. A force sensor (1000), preferably for detecting forces occurring on a head, the force sensor comprising:
5 an active layer (1001), wherein an electrical variable of the force sensor (1000) depends on a force acting on the active layer (1001) in such a way that a change in the electrical variable is caused by a change in the force acting on the active layer (1001);
characterized in that
10 the force sensor (1000) comprises an attachment (1002) which is arranged relative to the active layer (1001) in such a way that a force acting on the force sensor (1000) from the outside is conducted onto the active layer (1001) by means of the attachment (1002).
- 15 2. The force sensor (1000) according to claim 1, wherein the force sensor (1000) is designed in such a way that, in the event of an increase in the force acting on the active layer (1001), the electrical variable drops, preferably continuously and/or proportionally; and/or
wherein the force sensor (1000) is designed in such a way that, in the event of a
20 reduction in the force acting on the active layer (1001), the electrical variable rises, preferably continuously and/or proportionally.
- 25 3. The force sensor (1000) according to one of the preceding claims, wherein the force sensor (1000) is designed in such a way that, in an unloaded state of the active layer (1001), an electrical contact of the force sensor (1000) is interrupted, and in such a way that the electrical contact is closed by the force acting on the active layer (1001) in order to make the change in the electrical variable measurable as a function of the change in the force acting on the active layer (1001).
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4. The force sensor (1000) according to claim 3, wherein the active layer (1001) comprises a first substrate (1004) and a second substrate (1006) which, in the unloaded state of the active layer (1001), are spaced apart from one another and thereby interrupt the electrical contact, wherein the two substrates (1004, 1006)

are arranged in such a way that the substrates (1004, 1006) come into contact with one another by the force acting on the active layer (1001) and thereby close the electrical contact.

- 5 5. The force sensor (1000) according to claim 4, wherein the force acting on the active layer (1001) acts on an active surface (1001a) of the active layer (1001), wherein the active surface (1001a) is a surface of the first substrate (1004) or of the second substrate (1006).
- 10 6. The force sensor (1000) according to one of the preceding claims, wherein the attachment (1002) has a first side surface (1002b) which faces the active layer (1001) and/or the active surface of the active layer (1001), and wherein the attachment (1002) has a second side surface (1002a) which faces away from the active layer (1001) and/or the active surface of the active layer (1001), preferably
15 wherein the attachment (1002) is designed to direct the force acting on the force sensor (1000) from the outside onto the active layer (1001) and/or the active surface (1001a) of the active layer (1001) via the second side surface (1002a), through the attachment (1002) and via the first side surface (1002b).
- 20 7. The force sensor (1000) according to one of the preceding claims, wherein a first cross section through the attachment (1002) has a larger cross-sectional area than a second cross section through the attachment, wherein the second cross section is further away from the active layer (1001) and/or the active surface of the active layer (1001) than the first cross section.
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8. The force sensor (1000) according to one of the preceding claims, wherein the attachment (1002) tapers in a direction away from the active layer (1001) and/or the active surface of the active layer (1001).
- 30 9. The force sensor (1000) according to one of the preceding claims, further comprising a carrier (1003), preferably a wafer, for carrying the active layer (1001) and the attachment (1002).

10. The force sensor (1000) according to claim 9, wherein the attachment (1002) is arranged between the active layer (1001), in particular the second substrate (1006), and the carrier (1003), in particular wafer.
- 5 11. The force sensor (1000) according to claim 9, wherein the active layer (1001) is arranged between the attachment (1002) and the carrier (1003), in particular wafer, preferably wherein the second substrate (1006) is arranged between the first substrate (1004) and the carrier (1003), in particular wafer, and the first substrate (1004) is arranged between the attachment (1002) and the second substrate (1006).
- 10
12. A sensor group, comprising: a first force sensor (1000-1) according to one of the preceding claims and a second force sensor (1000-2) according to one of the preceding claims, wherein the first force sensor (1000-1) and the second force sensor (1000-2) are electrically connected in parallel with one another.
- 15
13. An assembly (100), comprising:
a force sensor (1000) according to one of the preceding claims 1 to 11;
a further sensor (102), which is designed to emit and/or to receive a signal via an active sensor surface (101) of the further sensor (102);
20 wherein the force sensor (1000) is mounted on a side surface, preferably opposite the active sensor surface (101), of the further sensor (102) in such a way that the attachment (1002), in particular the second side surface (1002a) thereof, faces away from the side surface of the further sensor (102).
- 25
14. The assembly (100) according to claim 13, wherein the further sensor (102) is an ultrasound probe, and wherein the signal is an ultrasound signal.
15. A set (1) for positioning sensors on opposite areas of a head, the set (1) comprising:
30 - one or more force sensors (1000, 1000-1, 1000-2) each according to one of the preceding claims 1-11;
- a headbracket (2), which is configured to at least partially extend around the head;

- sensor holders (3) arranged on opposite areas of the headbracket (2), which are configured to receive at least one of the force sensors in each case; and
- a nosebracket (4) connected to the headbracket (2), which is configured to support the headbracket (2) on a back of the nose of the head.

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16. The set according to claim 15, wherein each of the force sensors is received in another of the sensor holders arranged on opposite areas of the headbracket in such a way that a force caused by the head on the force sensor (1000) acts on the active layer (1001) of the force sensor via the attachment (1002).

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17. The set according to claim 15 or 16, wherein the set comprises a first assembly (100), which includes the first of the force sensors (1000-1), wherein the set comprises a second assembly (100), which includes a second of the force sensors (1000-2), and wherein each of the two assemblies (100) comprises a further sensor (102), which is configured to emit a signal via an active sensor surface (101) of the further sensor (102) in the direction of the head and/or to receive the signal from the direction of the head and wherein in each of the assemblies (100) the respective force sensor (1000) is mounted on a side surface, preferably opposite the active sensor surface (101), of the respective further sensor (102) in such a way that the attachment (1002) of the respective force sensor (1000-1, 1002-2), in particular the second side surface (1002a) thereof, faces away from the side surface of the respective further sensor (102).

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18. The set according to claim 17, wherein the sensor holders (3) arranged on opposite areas of the headbracket (2) are configured to receive at least one of the assemblies (100) together with the respective further sensor (102) thereof in each case.

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19. The set according to claim 17 or 18, wherein in each of the assemblies (100) the further sensor (102) is an ultrasound probe and the signal is an ultrasound signal.

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20. The set according to one of the preceding claims 15 to 19, wherein the force sensors (1000-1, 1000-2) are electrically connected in parallel with one another and/or wherein the electrical resistances of the force sensors (1000-1, 1000-2) are electrically connected in parallel.

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21. The set according to one of the preceding claims 15 to 20, wherein the nosebracket (4) is connected to the headbracket (2) in an area of the headbracket (2) approximately centrally between the sensor holders (3).

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22. The set according to one of the preceding claims 15 to 21, wherein the headbracket (2) at least partially extends around an axis (A) in a first plane running perpendicular to the axis (A), and wherein the nosebracket (4) intersects the first plane, preferably in a direction approximately perpendicular to the first plane.

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23. The set (1) according to one of the preceding claims 15 to 22, wherein the nosebracket (4) has an end piece (5) at an end opposite the headbracket (2), wherein the end piece (5) has a preferably approximately bracket-shaped indentation aligned approximately along the axis (A), which is configured to prevent a relative movement from the nosebracket (4) to the back of the nose in a direction parallel to a frontal plane of the head and parallel to the first plane.

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24. A sensor holder (3) for receiving at least one sensor,
the sensor holder (3) comprising:

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a force sensor (1000) according to one of the preceding claims 1-11;

a container with a preferably cylindrical interior space (6), preferably an approximately cylindrical recess (6), for receiving the force sensor (1000), wherein the container has an opening (7) on one side, preferably for inserting at least a part of the force sensor into the interior space (6), and the interior space (6) is at least partially delimited by a bottom side (8) of the container opposite the opening (7) and by at least one side surface (9) of the container, preferably wherein the bottom side and the at least one side surface of the container are configured to support the force sensor (1000) received in the interior space, preferably wherein the opening (7) is defined by an edge of the recess.

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25. The sensor holder (3) according to claim 24, wherein the sensor holder comprises an assembly (100) which includes the force sensor (1000), and wherein the assembly (100) comprises a further sensor (102), which is designed to emit and/or to receive a signal via an active sensor surface (101) of the further sensor,

and wherein in the assembly (100) the force sensor (1000) is mounted on a side surface, preferably opposite the active sensor surface (101), of the respective further sensor (102) in such a way that the attachment (1002) of the force sensor (1000), in particular the second side surface (1002a) thereof, faces away from the side surface of the further sensor (102).

26. The set according to any one of the claims 15 to 23 or the sensor holder according to any one of the claims 24 to 25, wherein each force sensor (1000) or each assembly (100) is arranged in one of the sensor holders or in the recess of the sensor holders.

27. Use of a force sensor (1000) according to one of the claims 1 to 11, a sensor group (1000-1, 1000-2) according to claim 12, an assembly (100) according to one of the claims 13-14, a set (1) according to one of the claims 15-23 or 26, or a sensor holder (3) according to one of the claims 24-26 for detecting a carlottery movement of a skull.

28. Computer-aided method for detecting a carlottery movement of a skull of a head by means of a set (1) according to one of the claims 15-23 or 26 arranged on the head, the method comprising:
detecting an electrical signal generated by means of the electrical variable of at least one of the force sensors (1000-1, 1000-2); and
detecting the carlottery movement based on the detected electrical signal.

29. The method according to claim 28, wherein the electrical signal is a periodic electrical signal and the carlottery movement is detected by means of a change in the amplitude of the periodic electrical signal.

30. The method according to claim 28 or 29, wherein the at least one force sensor (1000-1, 1000-2) is arranged on the head by means of the set in such a way that a force caused by the carlottery movement acts on the active layer (1001) of the at least one force sensor via the attachment (1002).

31. The method according to claim 30, wherein the electrical signal correlates with the force caused by the carlottery movement in such a way that a change in the

force caused by the carlottery movement causes a change in the amplitude of the electrical signal.

32. Computer-aided method for determining a physiological parameter of a patient
5 by means of at least one force sensor (1000) according to one of the claims 1-11
arranged on a region (1050) of a body part, preferably an artery, of the patient,
the method comprising:

detecting an electrical signal generated by means of the electrical variable of the
force sensor (1000); and

10 determining the physiological parameter based on the detected electrical signal.

33. The method according to claim 32, wherein the force sensor (1000) is arranged
on the region (1050) in such a way that a force caused by the region (1050) acts
on the active layer (1001) of the at least one force sensor (1000) via the
15 attachment (1002).

34. Computer-aided method for generating a control signal for a software application
by means of one or more force sensors (1000) according to one of the claims 1 to
11 or a set (1) according to one of the claims 15-23 or 26 arranged on a body part
20 (1040), preferably a head, the method comprising:

detecting a pattern in an electrical signal generated by means of the electrical
variable of at least one of the force sensors (1000-1, 1000-2); and

in response to the detected pattern, generating a control signal for a function of
the software application.

25 35. The method according to claim 34, wherein different detected patterns
correspond to control signals of different functions of the software application.

36. The method according to claim 34 or 35, wherein at least one of the force sensors
30 (1000-1, 1000-2) is arranged on the body part (1040) preferably by means of the
set (1) in such a way that a force caused by a movement of a muscle on the body
part (1040) acts on the active layer (1001) of the at least one force sensor (1000-
1, 1000-2) via the attachment (1002).

37. The method according to one of the claims 28-36, further comprising:
converting the electrical variable of the at least one force sensor (1000-1, 1000-2) into the electrical signal by means of an electrical circuit, preferably wherein the electrical variable is an electrical resistance and the electrical signal is an electrical voltage signal.

38. A force sensor (1000) for detecting forces occurring on a head, the force sensor comprising:
an active layer (1001), wherein an electrical variable of the force sensor (1000) depends on a force acting on the active layer (1001) in such a way that a change in the electrical variable is caused by a change in the force acting on the active layer (1001);
wherein the force sensor (1000) comprises an attachment (1002) which is arranged relative to the active layer (1001) in such a way that a force acting on the force sensor (1000) from the outside is conducted onto the active layer (1001) by means of the attachment (1002);
characterized in that the force sensor further comprises:
a carrier (1003), preferably wafer, for carrying the active layer (1001) and the attachment (1002).

39. The force sensor (1000) according to claim 38, wherein the attachment (1002) is arranged between the active layer (1001) and the carrier (1003), in particular wafer, or
wherein the active layer (1001) is arranged between the attachment (1002) and the carrier (1003), in particular wafer.