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Positioning with AIS data transmission

The invention concerns a method for AIS data transmission by means of AIS standard-compliant AIS signals, wherein AIS data to be transmitted are converted
5 into AIS signals on the transmitter side and transmitted via a main channel, wherein the AIS signals are received in an AIS receiver and converted back into received AIS data, wherein on the transmitter side a positioning signal is transmitted via an auxiliary channel present in addition to the main channel, which auxiliary channel on the receiver side makes it possible to determine the own geoposition of
10 the AIS receiver. The invention also concerns a corresponding AIS transmitter, a corresponding AIS receiver and an AIS transceiver. The invention also concerns a system of AIS transmitters and receivers as defined in Claim 12 and a computer program as defined in Claim 13 and 14.

15 A generic procedure is known from:

Gregory Johnson ET AL: „Feasibility Study of R-Mode using AIS Transmissions. Investigation of possible methods to implement a precise GNSS independent timing signal for AIS transmissions”, 29. August 2014.

20 AIS is the abbreviation for the Automatic Identification System, which is used in ship traffic for communication between ships and with stations on land or in the air or in space. The AIS data transmission is used by the ships e.g. for collision avoidance. The AIS signals are used for the general situation picture on the ship and on the coast. In addition, a global picture of the ship's movements can be created,
25 whereby the AIS signals can also be received via satellite. For AIS data transmission, the AIS data to be transmitted is converted into AIS signals by the transmitter, e.g. by modulation, and the AIS signals are transmitted by radio. Two channels in the VHF maritime radio range are used for this purpose, namely AIS1 = channel 87B and AIS2 = channel 88B. The range of the radio transmission is therefore de-
30 termined by the propagation conditions in the FM frequency range.

In general, there is an increasing dependence on satellite navigation in the navigation of ships. Consequently, risks are to be expected if the global navigation system used is disturbed or fails, or if reception conditions are inadequate.

- 5 The inventor therefore has the task of making the ship's command safer with regard to such problems in satellite navigation.

This task shall be solved by an AIS data transmission procedure in accordance with claim 1. The invention has the advantage that by using the AIS data transmission, which continues to be AIS-compliant, an additional possibility of determining
10 the own geoposition of an AIS receiver and thus of a ship equipped with such an AIS receiver, independent of satellite navigation systems, is made possible. According to the invention, the AIS signals are redesigned so that they can be simultaneously detected and used as positioning signals at the AIS receiver. The original
15 AIS signal is only changed so strongly that it can still be received at standard AIS receivers, i.e. it is standard-compliant.

A major advantage of the invention is that the actual transmission of the AIS data and AIS signals can continue to be AIS standard-compliant, so that all AIS receivers and AIS transceivers already in use can also receive the AIS data of an extended AIS transmitter designed according to the invention, but without using the
20 positioning signal. However, in order to use the positioning signal to determine one's own geoposition, an appropriate upgrade of such AIS receivers or transceivers is required to receive and evaluate the positioning signal, but this can be done
25 at the appropriate time depending on the user, equipment operator or ship operator. Especially for new equipment of ships, the extended AIS receivers or AIS transceivers, which can receive and evaluate the positioning signal, can be provided as equipment. The additional effort required for this is comparatively low, since depending on the implementation of the auxiliary channel, no hardware modifications
30 are required, but the extension can be carried out in the form of software enhancements, or at most minor hardware changes are necessary. A pure hardware implementation of the auxiliary channel is also advantageously possible.

AIS standard-compliant AIS signals are understood in particular to be AIS signals that comply with ITU Recommendation ITU-R M.1371-5 and/or its current versions.

- 5 The AIS data to be transmitted, the data contained in the positioning signal and the received AIS data may be realized in whole or in part in the form of binary data (bits) and/or not yet decided soft values of such binary data which are used for decoding the AIS data (in the sense of soft decision decoding). For example, soft values of the received AIS data and soft values of the data contained in the positioning
10 ing signal can be processed on the receiver side to provide the received AIS data and the data contained in the positioning signal.

The term "channel" used for the main channel and the auxiliary channel is to be understood as a channel in the telecommunications sense, i.e. as any kind of
15 transmission path for wireless signal transmission. The main channel for AIS data transmission according to the AIS standard is either channel AIS1 or channel AIS2 in conjunction with a specific modulation type, with automatic switching between these channels. Any other part of the signal space approved for AIS signal transmission may be used as an auxiliary channel, e.g. in the AIS frequency range or in
20 the vicinity of the AIS frequency range, e.g. in case of free frequency gaps. A signal space that is not intended for the transmission of AIS signals can also be used as an auxiliary channel. The auxiliary channel can, for example, be implemented by a different modulation type of signal transmission than the modulation type of the main channel. For the main channel, an AIS-standard modulation type can be
25 used as the modulation type, e.g. any type of frequency shift keying (FSK). In particular, the GMSK modulation (Gaussian Minimum Shift Keying) can be used for the main channel. This means that only little bandwidth is required for the transmission of the AIS signals.

- 30 However, the auxiliary channel can also be implemented differently from another modulation type of the main channel, e.g. by a time-division multiplexed transmission (temporal offset between the transmission of the AIS signals and the positioning signal), or by using the other AIS channel, i.e. either AIS1 or AIS2, depending on whether it is currently free and is not used for the own transmission of the AIS

signals. In particular, free time slots in one of the AIS channels can be used for the transmission of the positioning signal and thus for the realization of the auxiliary channel.

- 5 The positioning signal is thus transmitted within the AIS data transmission. Accordingly, the auxiliary channel can also be part of the AIS data transfer. The positioning signal, which can also be designed as a synchronization signal, can, for example, be in the form of signal patterns known from the transmitter for positioning on the receiver, whereby the original data contents of the AIS data transmission, i.e.
- 10 the AIS data, are not changed. The positioning signal can also be a ranging signal, e.g. in the form of a pseudorandom sequence (Pseudo Random Noise, PRN).

In accordance with an advantageous further training of the invention, it is intended that the AIS signals from the main channel are evaluated on the receiver side in

15 order to form the received AIS data, and that the positioning signal from the auxiliary channel is additionally evaluated on the receiver side in order to determine the own geoposition of the AIS receiver. In this way, an extended AIS receiver can determine both the AIS data and its own geoposition using the positioning signal. An AIS receiver not yet equipped to evaluate the positioning signal can nevertheless

20 receive and output the AIS data as before.

The geoposition of the AIS transmitter is known to the AIS receiver, which wants to evaluate the positioning signal. This can be realized in the way that the AIS transmitter is part of a reference station, e.g. along a coast of land-based reference sta-

25 tions, or the data "position of the vessel" is taken directly from the received AIS data. In the latter case, the AIS transmitter may also be located on board a ship so that a fixed geoposition of the AIS transmitter need not be assumed.

In accordance with an advantageous further training of the invention, the "position

30 of the ship" contained in the received AIS data is to be compared on the receiver side with the own geoposition determined from the positioning signal. In the AIS signal or within the AIS data, the "position of the ship", which is usually determined by a global navigation system such as GPS or Galileo, is included anyway. The in-

dependent determination of the geoposition based on the positioning signal provides a redundant quantity which can be used, for example, to control the "position of the ship" transmitted via the AIS signals.

5 In accordance with an advantageous further training of the invention, it is intended that the AIS signals transmitted via the main channel are not influenced by the transmission of the positioning signal on the auxiliary channel, or only to the extent that AIS receivers not set up to evaluate the positioning signal can nevertheless convert the AIS signals to the received AIS data. In this way, especially existing
10 AIS receivers not equipped to evaluate the positioning signal can continue to be used and the AIS signals can be received there and converted to AIS data. Possible minor influences on the AIS signals in the main channel by the data transmission on the auxiliary channel are filtered out by filter measures already present in the AIS receiver.

15

According to the invention, the positioning signal is to be transmitted by amplitude modulation of the AIS signals. This allows a technically simple realization of the auxiliary channel. The signal patterns of the positioning signal known from the transmitter can thus be applied to the AIS signal by simple amplitude modulation.

20 The AIS signals continue to comply with the AIS standard, e.g. by containing the information to be transmitted in the phase position of the signal. An additional amplitude modulation does not change this phase position. The modified AIS signals can therefore be demodulated by a standard AIS receiver. An extended AIS receiver can detect the amplitude modulated AIS signals with respect to the inherent
25 additional signal pattern, i.e. the positioning signal, and simultaneously receive the unchanged AIS data from the AIS signals. The AIS signals modified with additional amplitude modulation according to the invention can be used by AIS base, land or reference stations. Currently AIS signals with constant amplitude are used.

30 In accordance with an advantageous further training of the invention, it is intended that the positioning signal is designed as a pilot signal, as a synchronization signal, as a pseudo-random signal sequence or as a combination thereof. This has the advantage that the positioning signal can still be detected well on the receiver side even with weak or disturbed signal transmission.

In accordance with an advantageous further training of the invention, it is intended that the positioning signals of at least two different AIS transmitters are evaluated on the receiver side in order to determine the own geoposition of the AIS receiver. In this way, the own geoposition of the AIS receiver can be determined e.g. by a
5 time-of-arrival detection method. If the positioning signals of at least three different AIS receivers are evaluated on the receiver side, the own geoposition of the AIS receiver can be determined according to a time-difference-of-arrival method, which enables an even higher accuracy.

10 The task mentioned at the beginning is also solved by an AIS transmitter which is set up to carry out the transmitter-side procedural steps of a procedure of the kind described above. The advantages described at the beginning can also be realized with this. The transmitter-side process steps are in particular the conversion of the AIS data to be transmitted into AIS signals, e.g. by modulation, and the transmis-
15 sion of these AIS signals via the main channel, as well as the transmission of the positioning signal via the auxiliary channel. Depending on the realization of the auxiliary channel, these process steps can be realized in the AIS transmitter, e.g. by appropriate programming, i.e. by extending or changing the software of the AIS transmitter.

20

In accordance with an advantageous further training of the invention, it is provided that the AIS transmitter comprises a positioning signal generator for generating the positioning signal and/or an input for supplying an externally generated positioning signal, wherein the AIS transmitter comprises a positioning signal transmitter to
25 which the positioning signal is supplied and which is arranged to transmit the positioning signal via the auxiliary channel. The positioning signal generator can be implemented in the form of one or more circuit components (hardware), by a software extension or a combination thereof.

30 The above-mentioned task is also solved by an AIS receiver, which is set up to carry out the receiver-side procedural steps of a procedure of the kind described above. The advantages described at the beginning can also be realized with this. The receiver-side process steps are, in particular, receiving the AIS signals from the main channel and converting the received AIS signals back into received AIS

data, e.g. by demodulation, as well as receiving the positioning signal and, if necessary, making it available to other users and/or determining the AIS receiver's own geoposition. Depending on the realization of the auxiliary channel, these process steps can be realized in the AIS receiver, e.g. by appropriate programming,
5 i.e. by extending or changing the software of the AIS receiver.

In accordance with an advantageous further training of the invention, it is provided that the AIS receiver comprises a positioning signal receiver arranged to receive the positioning signal via the auxiliary channel, the positioning signal receiver being
10 followed by a position determination unit arranged to determine the own geoposition of the AIS receiver from the auxiliary channel on the basis of the positioning signal provided by the positioning signal receiver. The positioning unit may be designed as part of the AIS receiver or as a separate device from it.

15 The equipment described above, namely the AIS transmitter and the AIS receiver, may also be part of an AIS transceiver, i.e. an equipment which is capable of both transmitting and receiving AIS signals. Accordingly, the task mentioned at the beginning is also solved by an AIS transceiver comprising an AIS transmitter of the type described above and an AIS receiver of the type described above.

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The above mentioned task is also solved by a system of AIS transmitters and AIS receivers:

- a) at least one AIS transmitter of the type described above,
- b) at least one AIS receiver of the type described above,
- 25 c) at least one AIS receiver which does not have a positioning signal receiver, where the AIS data transmitted by the AIS transmitters can be received and evaluated both by AIS receivers in accordance with feature b) and by AIS receivers in accordance with feature c). In this way, mixed operation is possible in the system with "old" AIS receivers, which are not set up to evaluate the positioning signal,
30 and AIS receivers designed in accordance with the invention, whereby the AIS data can be exchanged between all participants in accordance with the standard. However, the advantages of the invention with regard to the independent determination of one's own geoposition can only be realized for data transmission between AIS transmitters according to characteristic a) and AIS receivers according

to characteristic b). Nevertheless, the data transmission still complies with AIS standards and is therefore downward compatible.

5 The above task shall also be solved by a computer program containing program code means arranged to perform the transmitter-side procedural steps and/or the receiver-side procedural steps of the procedure of the kind described above when the computer program is executed on a computer. The advantages described at the beginning can also be realized with this. The computer can be a computer, e.g. a microcomputer or microprocessor, an AIS transmitter, an AIS receiver or an AIS
10 transceiver.

In accordance with an advantageous further training of the invention, the auxiliary channel can be realized e.g. by one of the following design forms or by a combination of several of the following design forms:

15

1) Transmission of the positioning signal in such a way that it lies in the frequency domain outside the AIS signals or close to the AIS signals, e.g. by OFDM signals (OFDM - Orthogonal Frequency Division Multiplexing) which lie close to the AIS signals.

20

2) Transmission of the positioning signal as a spread spectrum signal that can be superimposed on the AIS signals or other signals.

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3) Transmission of the positioning signal by amplitude modulation of the AIS signals.

4) Transmission of the positioning signal as an additional signal in the AIS frequency range, e.g. by repeating the AIS signals as positioning signals.

30

5) Transmission of the positioning signal via the other AIS channel, which is not used for the transmission of the AIS signals.

- 6) Transmission of the positioning signal by another type of modulation that can be superimposed on the modulation type used for the transmission of the AIS signals by these AIS signals without conflict.
- 5 7) Time division multiplex for the transmission of the positioning signal, i.e. transmission at times when no AIS signals are transmitted, e.g. free time slots of the AIS data transmission.

In all cases, AIS receivers that are not equipped to evaluate the positioning signal
10 can still receive and evaluate the AIS signals, even if interference may occur, for example, with the above-mentioned types 2, 4 and 5, but is picked up in the AIS receiver like an increased noise level and filtered out accordingly by the receive filters or other measures. With the aforementioned design 3, from the point of view of the AIS receiver, there are fluctuations in the signal strength of the AIS signals,
15 but this can also occur within the scope of regular AIS signal transmission, e.g. in the event of range fluctuations, and must therefore not lead to falsification.

The invention will be explained in more detail in the following using examples and drawings.

20

It shows

- Figure 1 first version of a system of AIS transmitters and AIS receivers, and
- 25 Figure 2 second version of a system of AIS transmitters and AIS receivers, and
- Figure 3 the geopositioning of a ship using land-based stations and
- 30 Figure 4 The geopositioning of a ship using other ships.

In the figures, the same reference signs are used for the corresponding elements are used.

Figure 1 shows a schematic representation of a system with one AIS transmitter 1 and two AIS receivers 2, 3. The AIS transmitter 1 is designed in accordance with the invention with the transmitter-side positioning signal transmission. The AIS receiver 2 is also designed according to the invention so that it can receive and evaluate the positioning signals of the AIS transmitter 1 and other AIS transmitters designed in this way. The AIS receiver 3 is a standard AIS receiver which is not set up to evaluate the positioning signal.

The AIS transmitter 1 receives AIS data 5 to be transmitted, e.g. from sensors and/or other devices. The AIS data to be transmitted are, for example, the ship identification of the ship on which the AIS transmitter 1 is used, as well as the position of the ship in the form of geographical data, which can be provided, for example, by a global navigation system.

The AIS data 5 to be transmitted are fed to an AIS signal generator 10 of the AIS transmitter 1. This converts the AIS data 5 into AIS signals which can then be transmitted wirelessly via the main channel 41, one of the permitted AIS channels. In a positioning signal generator 11, the positioning signal is generated, which is fed to a positioning signal transmitter 12, which generates a position signal that can be transmitted, e.g. by corresponding modulation. This positioning signal is then transmitted by the positioning signal transmitter 12 via an auxiliary channel 42 in addition to the main channel 41. The transmission of the AIS signals via the main channel 41 and the positioning signal via the auxiliary channel 42 can be done via the same antenna of the AIS transmitter 1 or via separate antennas.

25

The AIS signals transmitted by the AIS transmitter 1 via transmission path 4 and the positioning signal can be received by any AIS receiver within radio range. However, reception including evaluation of the positioning signal is only possible with appropriately upgraded AIS receivers corresponding to the AIS receiver 2 shown here. The AIS receiver 3, designed according to the previous standard, can evaluate the AIS signals of the AIS transmitter 1 transmitted via the transmission path 4 via the main channel 41 without any problems as before, i.e. convert the AIS signals of the main channel 41 into received AIS data 7 via its AIS signal converter 30 and output them to other devices. The positioning signal transmitted via

the auxiliary channel 42 may also arrive physically at the AIS receiver 3 or its antenna, but does not lead to any further evaluation, as indicated in figure 4 by the arrow 40, which is only dashed.

5 In the AIS receiver 2, the AIS signals are also received by the main channel 41 and converted by an AIS signal converter 20 into received AIS data, which correspond to the AIS data 5 except for possible transmission errors, and output as received AIS data 6. In the AIS receiver 2, the positioning signal is additionally received from the auxiliary channel 42 and demodulated via a positioning signal receiver 21 of the AIS receiver 2 and provided as positioning signal or data contained therein or already as a separate geoposition of the AIS receiver 2 as output data 8.

As explained at the beginning, the invention also includes realization possibilities in which the auxiliary channel is coupled to the main channel in such a way that the transmission paths for the main channel 41 and the auxiliary channel 42 shown separately in figure 1 are combined in the representation. This is explained using the example in figure 2. With the design as shown in figure 2, the auxiliary channel is realized, for example, by amplitude modulation of the AIS signals emitted by the AIS transmitter 1.

Accordingly, in figure 2, the AIS transmitter 1 is again equipped with the AIS signal converter 10 and the positioning signal generator 11. In contrast to the version shown in figure 1, the AIS signals emitted by the AIS signal converter 10 are modulated in a modulator 13 with the positioning signal from the positioning signal generator 11 on the transmitter side, i.e. in the AIS transmitter 1, e.g. according to the amplitude modulation mentioned above. The AIS signals obtained in this way continue to meet the limits specified by the AIS standard, with the main channel 41 and the auxiliary channel 42 formed within the same signal transmission. These AIS signals are transmitted via the transmission path 4 to the AIS receiver 2 and the AIS receiver 3.

As already explained in figure 1, the AIS receiver 3 is not set up to evaluate the positioning signal. It receives the AIS signals transmitted via the transmission path

4, but can only evaluate the signal components of the main channel 41 and converts them into the received AIS data 7.

5 The extended AIS receiver 2 evaluates the positioning signal contained in the signal transmitted over the transmission path 4. The signal used for amplitude modulation is known to the extended AIS receiver 2. The signals received via transmission path 4 are fed to the AIS signal converter 20 in the AIS receiver 2 and in this case also to the positioning signal receiver 21. In this case, the positioning signal receiver 21 has a different technical design than the version of figure 1, since it
10 has to filter out or demodulate the portion of the positioning signal from the common signal in the version of figure 2.

As with the execution form of figure 1, the AIS data output by the AIS signal converter 20 is output as received AIS data 6. The positioning signal receiver 21 provides the recovered positioning signal or data contained therein or already the own
15 geoposition of the AIS receiver 2 as output data 8.

The position of the AIS transmitters 1 is known to the extended AIS receiver 2, e.g. by reference stations (e.g. along the coast) with known geopositions or by the position information being taken directly from the detected AIS signal.
20

The transmission time of the positioning signal and in particular of the amplitude-modulated AIS signal can be realized in various forms.

- 25 - The transmission time can be known to the AIS receiver in a global time reference system. The reference time can, for example, be provided by external sources. In this case, both runtime and runtime difference procedures can be used for positioning at the enhanced AIS receiver.
- 30 - The transmission time cannot be absolutely known at the extended receiver. The AIS transmitters or the reference stations then transmit the signal in a fixed time relation to each other (e.g. simultaneously). In this case, runtime difference procedures can be used for positioning at the extended receiver.

- The transmission time can be arbitrary. In this case, methods known from mobile radio (UMTS), for example, can be used which use so-called Local Measurements Units (LMU) to measure the transmission times. The measured transmission times are made available to the extended receivers via a suitable protocol.

The amplitude modulated AIS signals according to the invention can be transmitted not only by base, land or reference stations, but also by any other modified (extended) mobile AIS unit, e.g. on a ship itself.

The extended mobile AIS units have their own position determined either by AIS base, land or reference stations or by other positioning techniques. This position is transmitted by default in the AIS signal according to the AIS specification.

The extended mobile AIS units in turn transmit an amplitude modulated AIS signal, which can be used for positioning in adjacent extended AIS receivers. This allows large areas to be covered by an AIS-based positioning service with a few reference stations and a suitable user density.

The AIS system uses Gaussian Minimum Shift Keying (GMSK) as modulation method. The transmission signal

$$s(t) = s_0 e^{-i\varphi(t)} \quad (1)$$

in the baseband has a constant amplitude s_0 and describes an average amplitude, so to speak. The information to be transmitted is contained in the real-valued phase function $\varphi(t)$ and thus in the phase position of the transmitted signal. According to the invention an additional modulation of the signal amplitude can be added, e.g. by

$$s_0(t) = \tilde{s}_0(1 + a(t)) \quad (2)$$

with a real-valued time function $a(t)$. The transmission signal is thus

$$s(t) = \tilde{s}_0(1 + a(t)) e^{j\varphi(t)} \quad (3)$$

If the amplitude of $a(t)$ is selected such that the $(1 + a(t)) \geq 0$ phase position of the baseband signal according to equation (1) continues to be determined $\varphi(t)$

- 5 only by the information in the phase function. If this factor is negative, i.e. $(1 + a(t)) < 0$, it would correspond to a phase shift of 180°. Now you have the possibility to transmit another time signal in addition to the AIS signal.

- 10 This additional time signal can be the positioning signal (positioning, ranging), e.g. in the form of a signal known to the receiver (pilot signal, synchronization signal), for example a pseudo-random sequence (pseudo random noise, PRN). With its help, a so-called pseudo distance (pseudo-range) between transmitter and receiver can be determined using suitable methods known, for example, from satellite navigation or mobile radio positioning. By combining several pseudo distances,
- 15 the position of the receiver can be determined using known methods.

In this way, for example, the geolocation of the AIS receiver can be determined from the positioning signals of two different AIS transmitters using trilateration.

- 20 This is illustrated in figure 3 using an example where, on a ship 93 at sea, the AIS signals are received from two AIS land stations 92 arranged along a coast of 90 and located at known positions. Using the trilateration from the two positioning signals of the AIS 92 land stations, the ship 93 or its AIS receiver determines its own geolocation.

- 25 Figure 4 shows a case study in which two ships at sea 93, 94 each determine their own geolocation using the positioning signals of the AIS land stations 92. A third vessel 95 at sea 91 receives the AIS signals of the vessels 93, 94 and determines the own geolocation of the vessel 95 on the basis of the positioning signals contained therein which are transmitted via the auxiliary channel and on the basis of
- 30 the respective "position of the vessel" present in the actual AIS data transmission which thus indicate the own geolocation of the vessel 93 and the vessel 94.

P A T E N T K R A V

1. Fremgangsmåde til AIS-dataoverførsel ved hjælp af AIS-standardkonforme AIS-signaler, hvor AIS-data (5), som skal overføres, på sendersiden ændres til AIS-signaler og udsendes via en hovedkanal (41), hvor AIS-signalerne modtages i en AIS-modtager (2, 3) og ændres tilbage til modtagne AIS-data (6, 7), hvor der på sendersiden via en ud over hovedkanalen (41) forekommende hjælpekanal (42) udsendes et positioneringssignal, som på modtagersiden muliggør en bestemmelse af AIS-modtagerens (2, 3) egen geoposition, **kendetegnet ved, at** overførslen af positioneringssignalet sker ved hjælp af amplitudemodulation af AIS-signalerne.
5
2. Fremgangsmåde ifølge det foregående krav, **kendetegnet ved, at** AIS-signalerne fra hovedkanalen (41) evalueres på modtagersiden for at danne de modtagne AIS-data (6, 7), og positioneringssignalet fra hjælpekanalen (42) yderligere evalueres på modtagersiden for at bestemme AIS-modtagerens (2, 3) egen geoposition.
15
3. Fremgangsmåde ifølge det foregående krav, **kendetegnet ved, at** den i de modtagne AIS-data (6, 7) indeholdte "position af skibet" på modtagersiden sammenlignes med den ud fra positioneringssignalet bestemte egen geoposition.
20
4. Fremgangsmåde ifølge et af de foregående krav, **kendetegnet ved, at** de via hovedkanalen (41) overførte AIS-signaler ved hjælp af overførslen af positioneringssignalet på hjælpekanalen (42) ikke påvirkes eller kun påvirkes i et sådant omfang, at AIS-modtagere (3), som ikke er indrettet til evaluering af positioneringssignalet, alligevel kan ændre AIS-signalerne til de modtagne AIS-signaler (7).
25

5. Fremgangsmåde ifølge et af de foregående krav, **kendetegnet ved, at** positioneringssignalet er udformet som pilotsignal, som synkroniseringssignal, som pseudotilfældig signalsekvens eller som kombination deraf.
- 5 6. Fremgangsmåde ifølge et af de foregående krav, **kendetegnet ved, at** positioneringssignalerne af mindst to forskellige AIS-sendere evalueres på modtagersiden for at bestemme AIS-modtagerens (2, 3) egen geoposition.
- 10 7. AIS-sender (1), som er indrettet til udførelse af fremgangsmådetrinene på sendersiden i en fremgangsmåde ifølge et af de foregående krav.
- 15 8. AIS-sender ifølge krav 7, **kendetegnet ved, at** AIS-senderen (1) omfatter en positioneringssignalgenerator (11) til frembringelse af positioneringssignalet og/eller en indgang til tilførsel af et eksternt frembragt positioneringssignal, hvor AIS-senderen (1) omfatter en positioneringssignalsender (12, 13), hvortil positioneringssignalet er tilført, og som er indrettet til udsendelse af positioneringssignalet via hjælpekanalen (42).
- 20 9. AIS-modtager (2), som er indrettet til udførelse af fremgangsmådetrinene på modtagersiden i en fremgangsmåde ifølge krav 2.
- 25 10. AIS-modtager ifølge det foregående krav, **kendetegnet ved, at** AIS-modtageren (2) omfatter en positioneringssignalmodtager (21), som er indrettet til modtagelse af positioneringssignalet via hjælpekanalen (42), hvor der efter positioneringssignalmodtageren (21) er anbragt en positionsbestemmelsesenhed (22), som er indrettet til ved hjælp af det af positioneringssignalmodtageren (21) tilvejebragte positioneringssignal fra hjælpekanalen (42) at bestemme AIS-modtagerens (2, 3) egen geoposition.
- 30 11. AIS-transceiver, som omfatter en AIS-sender (1) ifølge et af kravene 7 til 8 og en AIS-modtager (2) ifølge et af kravene 9 til 10.

12. System af AIS-sendere (2) og AIS-modtagere (2, 3), omfattende:

- 5
- a) mindst en AIS-sender (1) ifølge et af kravene 7 til 8,
 - b) mindst en AIS-modtager (2) ifølge et af kravene 9 til 10,
 - c) mindst en AIS-modtager (3), som ikke omfatter nogen positionerings-signalmodtager (21),

10

hvor de af AIS-senderne (1) overførte AIS-data kan modtages og evalueres såvel af AIS-modtagerne (2) ifølge kendetegn b) som af AIS-modtagerne (3) ifølge kendetegn c).

15

13. Computerprogram med programkodemidler, som er indrettet til gennemførelse af fremgangsmådetrinene på sendersiden af fremgangsmåden ifølge et af kravene 1 til 6, når computerprogrammet udføres på en computer i en AIS-sender (1).

20

14. Computerprogram med programkodemidler, som er indrettet til gennemførelse af fremgangsmådetrinene på modtagersiden af fremgangsmåden ifølge krav 2, når computerprogrammet udføres på en computer i en AIS-modtager (2).

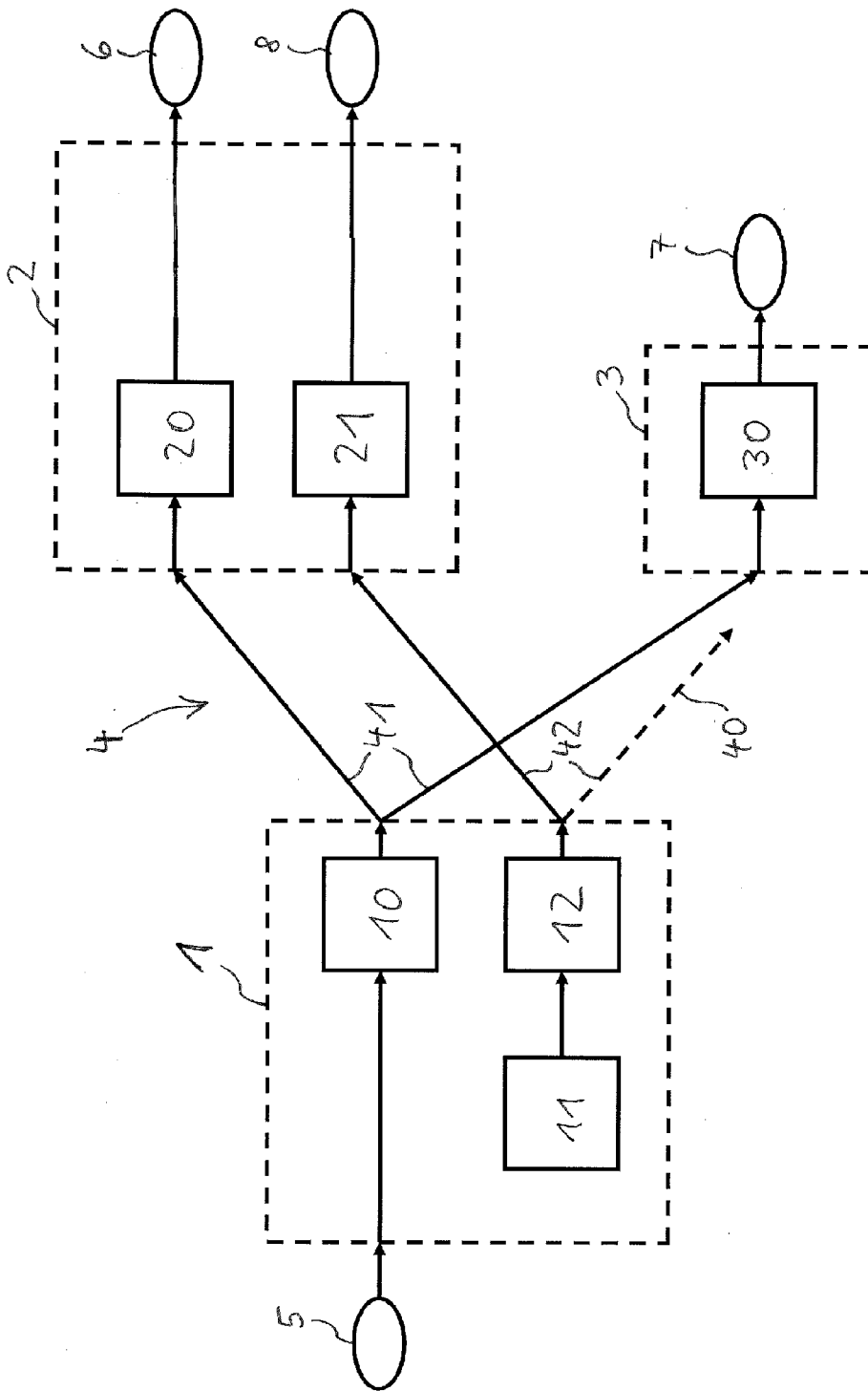


Fig. 1

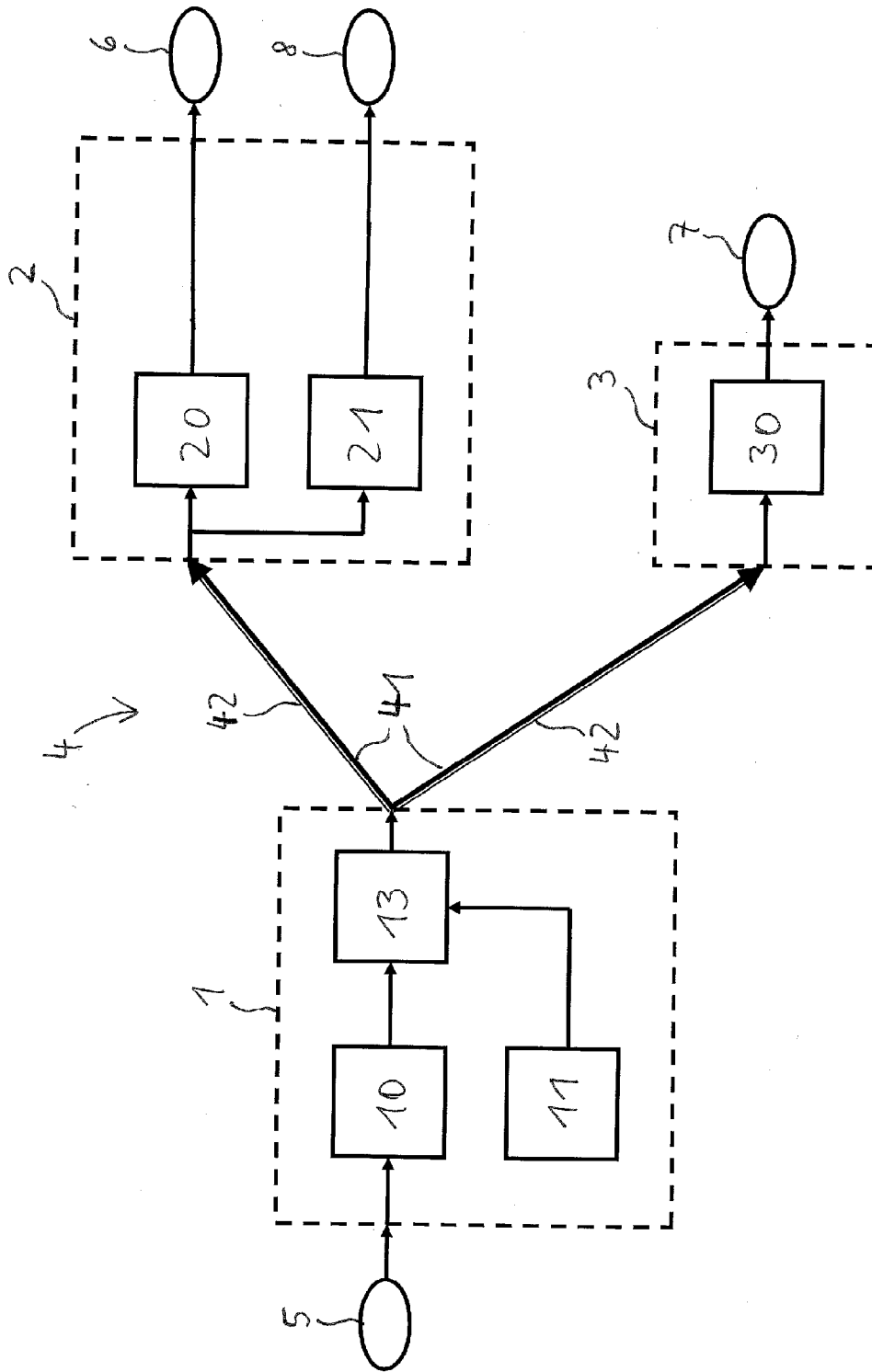


Fig. 2

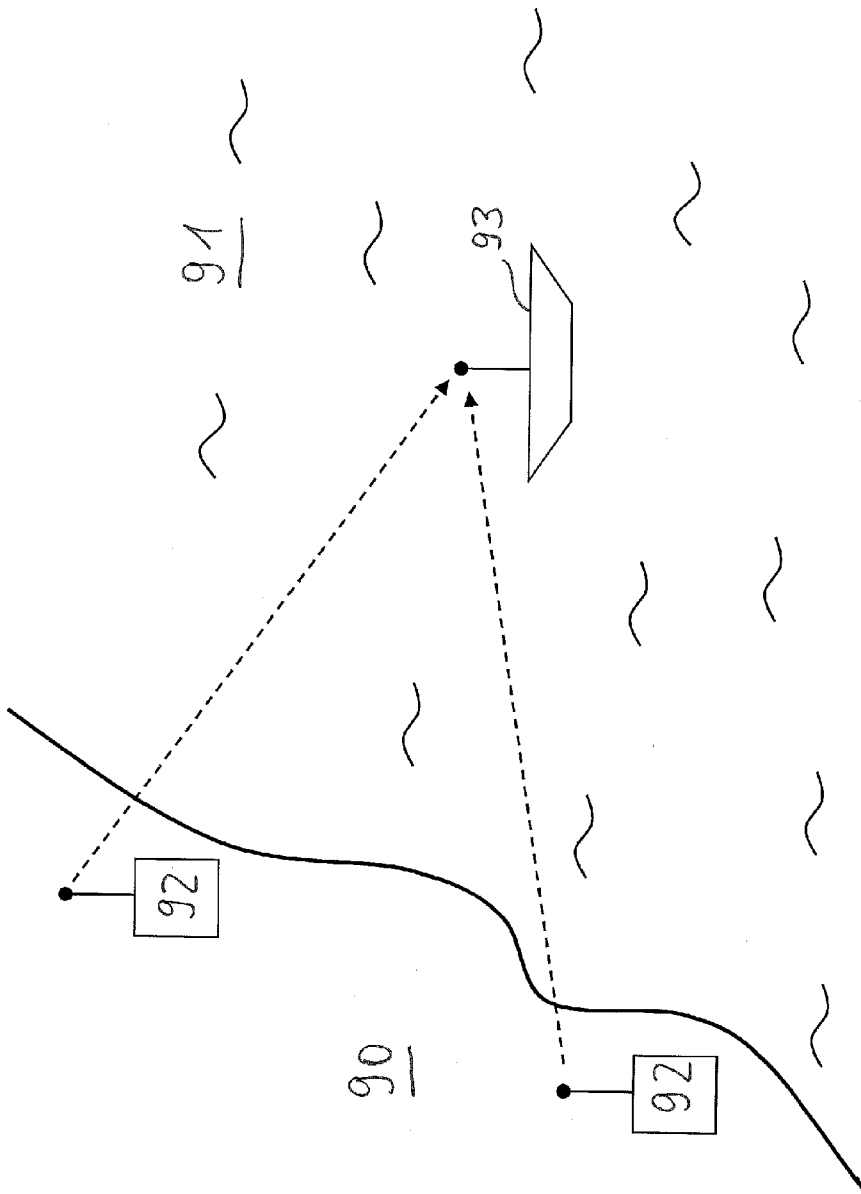


Fig. 3

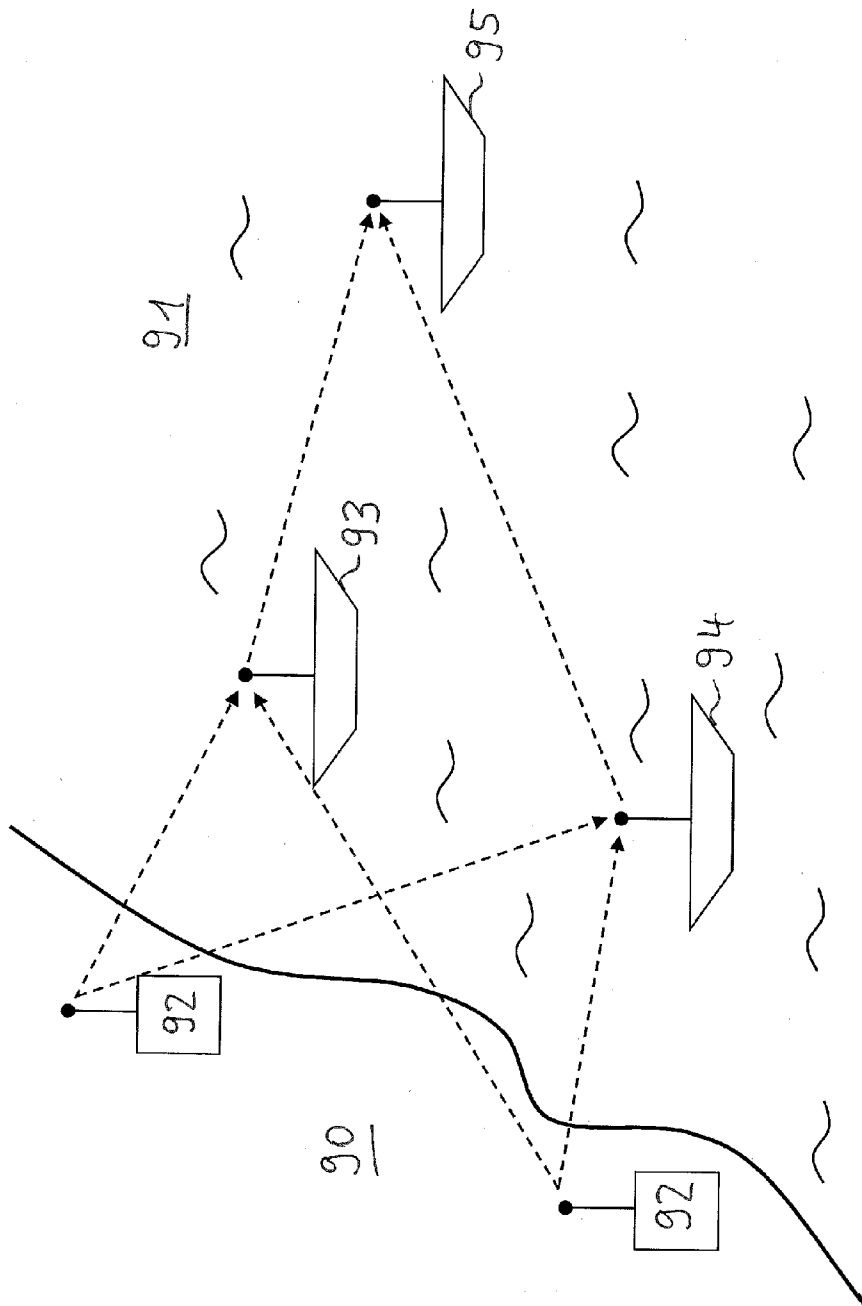


Fig. 4