

DIFFERENTIAL MEASURER OF THE PROPAGATION TIME OF A WAVE
AND DEVICE FOR IDENTIFYING THE PROPAGATION DIRECTION OF
A WAVE

The present invention relates to a differential measurer of the time interval which separates the arrival of the same wave on two antennas arranged at some distance one from the other. These measurers are
5 generally used in combination with an array of antennas in order to identify the propagation direction of a wave received by the array, it being possible for this wave to be electromagnetic, acoustic, seismic, etc.

One of the methods for carrying out these
10 measurements consists in using electronic circuits, such as microwave circuits, which analyze the phase and/or the amplitude of signals received by the antennas of the array. Identifying the propagation direction of a wave in three dimensions with known
15 measurers requires at least five antennas in the far field and seven in the near field. In addition, the phase measurement obtained can be ambiguous (to within 2π modulo).

The present invention makes it possible to
20 alleviate or, at least to reduce these drawbacks by optically processing signals received by the antennas making it possible to obtain a differential measurement of the propagation time of a wave and to identify the propagation direction of this wave. The number of
25 antennas used for identifying the propagation direction can then, possibly, be limited to three antennas in a far field and to five antennas in a near field for three-dimensional identification.

To this end, the subject of the invention is a
30 differential measurer of the propagation time of a wave, for measuring the interval between the arrival time of the same wave on two antennas situated in different locations, characterized in that it comprises in series a source device supplying a first light beam
35 and at least a second light beam, a device for superimposing light beams, a device for analyzing the light intensity level, and in that the source device is connected to the superposition device by a first path of the first light beam which comprises a first

electrooptic modulator comprising a modulation input coupled to a first antenna and by a second path of the second light beam which comprises in series a second electrooptic modulator comprising a modulation input
5 coupled to a second antenna and a retarder.

This measurer uses a method of differential measurement of the propagation time of a wave, for measuring the interval between the arrival time of the same wave on two antennas situated in different
10 locations, characterized in that a first light beam is modulated by the information emanating from the first antenna, then superimposed on the second light beam which has been modulated by the information emanating from the second antenna, then retarded by the sub-beam
15 for different durations, such that the beam obtained by this superposition has a more intense part corresponding to a sub-beam of known actual delay and equal to the said measurement.

The invention also proposes a device for
20 identifying the propagation direction of a wave, characterized in that it comprises n (where n is an integer at least equal to two) differential measurers, having part of the source device supplying the first light beam and one of the antennas in common.

25 The characteristics and advantages of the invention will appear more clearly on reading the description, made by way of example, and the figures which are appended to it which show:

- 30 - figure 1(a), a basic diagram of a first variant of the differential measurer, using a single source according to the invention,
- figure 1(b), a basic diagram of a second variant of the differential measurer using two sources according to the invention,
- 35 - figure 2(a), a first exemplary embodiment of the differential measurer with a spatial retarder according to the invention,

- figure 2(b), a second exemplary embodiment of the differential measurer with a dispersive fiber according to the invention,
- figure 3, a more detailed partial diagram of the differential measurer using a tunable laser source,
- figure 4, an exemplary embodiment of the device for identifying the direction of a wave according to the invention,
- figure 5, a more detailed partial diagram of the identifying device using a monochromatic source.

Figure 1(a) shows a first example of the differential measurer according to the invention. The time interval measured is that which separates the arrival time of the same electromagnetic wave H which is propagated along a given direction to two antennas A1 and A2 situated in different locations.

Within the source device 1, a monochromatic light source 11, such as, for example, a semiconductor laser or a solid-state pump laser, supplies, via optical fibers, a single-mode light beam to an optical splitter 12, such as an optical coupler for example. This optical splitter 12 separates the beam received into two beams 2' and 2'', preferably of the same amplitude. The beam 2', 2'' respectively, is directed via optical fibers toward the optical input of the electrooptic modulator 3' and toward the optical input of the electrooptic modulator 3'', respectively, of characteristics identical or similar to those of the electrooptic modulator 3'.

The electrical signals $s_1(t)$ and $s_2(t)$ produced by the antennas A1 and A2, respectively, on receiving the wave H are applied to the respective modulation inputs of the electrooptic modulators 3' and 3''. The electrical signal $s_1(t)$ emanating from the antenna A1 and the electrical signal $s_2(t)$ emanating from the antenna A2, respectively, modulate the light beam 2' and the light beam 2'' emanating from the optical

splitter 12, respectively. The electrooptic modulator modulates, for example, the light beam present on its optical input at the frequency of the electrical signal present at its modulation input. The light beams
5 emanating from the electrooptic modulators 3' and 3" thus become representative of electrical signals $s_1(t)$ and $s_2(t)$, respectively.

The retarder 4" makes the beam emanating from the modulator 3" undergo delays τ_i of various durations
10 and therefore provides a light beam which can be considered as comprising several sub-beams SF_i , each with its actual delay τ_i . The values of the durations of the delays τ_i are chosen between two extreme values, the separation of which is at most equal to twice the
15 propagation time of a plane wave from one antenna to the other along the straight line joining these two antennas. The retarder 4' makes the light beam emanating from the modulator 3' undergo a single delay τ_m such that its duration is equal to that of the median
20 delay applied to the beam emanating from the modulator 3" by the retarder 4".

A superposition device 5 superimposes the beam output from the retarder 4' with the beam output from the retarder 4".

25 After superposition, the resulting beam then has a maximum light intensity where (or when) the delay τ_i imposed by the retarder 4" corresponds to the propagation time of the wave when passing from the antenna A2 to the antenna A1 or conversely depending on
30 the inclination of the wave plane relative to the straight line joining these two antennas. An analysis device 6, placed at the output of the superposition device 5, splits the various parts P_i of the beam resulting from the superposition corresponding to the
35 aforementioned sub-beams SF_i and determines the part P_i where the light intensity is maximum. This analysis device comprises, for example, a linear array of photodetectors or a matrix of photodetectors in order to carry out the various tasks mentioned.

Figure 1(b) shows a second example of a differential measurer. In this case, the source device consists of two sources 11' and 11". The first source 11' is a monochromatic source which provides a light beam 2'. This light beam 2' is modulated in the electrooptic modulator 3' by the electrical signal $s_1(t)$ emanating from the antenna A1 during reception of the wave H. The second source 11" is a broadband source which supplies a light beam 2". This light beam 2" is modulated in the electrooptic modulator 3" by the electrical signal $s_2(t)$ emanating from the antenna A2 on receiving the wave H. The retarder 4" makes the sub-beams SF_i constituting the beam output from the modulator 3" undergo delays τ_i of durations which are dependent on the various wavelengths λ_i . The values of the durations of the delays τ_i are chosen between two extreme values, the separation of which is at most equal to twice the propagation time of a plane wave from one antenna to the other along the straight line joining these two antennas. The retarder 4' makes the light beam emanating from the modulator 3' undergo a single delay τ_m , such that its duration is equal to that of the median delay applied to the beam emanating from the modulator 3" by the retarder 4". The light beam output from the retarder 4" is superimposed with the beam output from the retarder 4' by the device 5. The device 6 then analyzes the light beam resulting from the superposition in order to determine the most intense sub-beam SF_i . The wavelength λ_i corresponding to the most intense sub-beam SF_i then makes it possible to find the propagation time $\tau_1 - \tau_2$ of the wave H from the antenna A2 to the antenna A1.

Let us consider the case where the propagation time of the electrical signals $s_1(t)$ and $s_2(t)$, respectively from the antennas A1 and A2, respectively, to the modulators 3' and 3", respectively and/or the propagation times of the optical signals from the modulators 3' and 3", respectively, to the superposition device 5 are not equal (bearing in mind

that the delay produced by the retarder 4" is not counted in these propagation times). The analysis device 6 will then have to take into account the propagation time differences existing within the measurer (except those induced by the retarder 4") in order to accordingly correct the result obtained by seeking the most intense sub-beam.

Figure 2(a) is a partial diagram which is more detailed than those of figures 1(a) and 1(b). It relates to an exemplary embodiment of the differential measurer with a spatial retarder 4".

The source device 1 provides two light beams 2' and 2". The light beams 2' and 2", respectively, are modulated within the modulators 3' and 3", respectively, by the electrical signals $s_1(t)$ and $s_2(t)$, respectively, emanating from the antennas A1 and A2, respectively, during reception of the wave H. The light beam output from the modulator 3' and the light beam output from the modulator 3", respectively, are collimated at infinity by collimators L1 and L2, respectively, symbolized by two lenses.

A reflecting mirror M1 reflects the light beam collimated by L1 in order to send it to the semireflecting mirror 5 via a spatial modulator C1.

The spatial modulator C1 is an optical corrector, the role of which is to compensate, by balancing, for the optical defects arising in the two beams to be superimposed, along the paths followed by these beams. This compensation is designed, for example, so that the quantity of light has a given value at the time when the superimposed beams corresponding to the abovementioned sub-beams are in phase to within a multiple of T , where T is the period of the received signal.

An exemplary embodiment of the modulator C1 is a modulator comprising a screen made from a liquid-crystal matrix. This matrix is controlled in order to exhibit, for example, regions which transmit to a

greater or lesser degree depending on the compensations to be obtained.

The light beam coming from the collimator L2 arrives directly on the semireflecting mirror 5 which it passes through, at least partially, in order to reach the spatial retarder 4". This spatial retarder 4", for example a retroreflector, causes the various delays mentioned in the description of Figures 1(a) and 1(b). The retroreflected beam, which comprises a group of variously delayed sub-beams is then sent back to the semireflecting mirror 5.

Instead of using a retarder 4", which makes the beam undergo delays which vary spatially in a discontinuous manner, the use of a retarder 4" generating delays which vary spatially in a continuous manner is possible.

The semireflecting mirror 5 superimposes the two beams, the first emanating from the electrooptic modulator 3', the second from the retarder 4". The two beams are then analyzed by the device 6. Whether the delays have been generated in a continuous or discontinuous manner, the analysis device 6 deduces the time taken by the wave H to reach the antenna A1 after having reached the antenna A2 of the sub-beam whose intensity is the maximum.

The measurers can be used in systems, such as radar systems, where the wave is relative to a periodic signal emitted by the system itself and received after reflection. In this case, the measurer knows the period T of the signal received by the antennas of the measurer.

The application of the delay to the light beam modulated by the signal emanating from the antenna receiving the first wave H is no longer essential. This is because the analysis of the signals will be able to be carried out by comparing received signals corresponding to two different periods of the transmitted signal. Thus the period $n + 1$ of the signal

from the antenna A2 can be compared with the period n of the signal from the antenna A1, or conversely.

Again by virtue of this knowledge of the period T by the measurer, a predetermined sampling per
5 duration T can be carried out before analysis by the device 6. By way of example, let us consider 200 sub-beams each offset from the others by a delay τ such that $200\tau = 2T$, so as to carry out an analysis over two periods. If the set of sub-beams is analyzed by the
10 device 5 using 1000 photosensitive elements side by side, a sampling of 20 per period T will be carried out while only taking account of one sub-beam out of $(200/2)/20 = 5$, using $1000/200 = 5$ photosensitive elements per sub-beam.

15 The role of the spatial modulator E is that of a shutter. It provides the abovementioned sampling. An exemplary embodiment of this modulator E consists of a modulator comprising, like the modulator C1, a screen formed by a liquid-crystal matrix. The nature of the
20 matrix constituting the modulator E differs from that making up the modulator C1 in that the control is an on/off control. The regions are transmitting for the parts to be sampled in the beam resulting from the superposition and do not allow the light forming the
25 other parts of the beam to be transmitted.

The light having passed through the modulator E reaches the analysis device 6. An exemplary embodiment of this analysis device 6 is a device comprising three successive matrices made respectively from photodiodes,
30 diodes and filters. Each photodiode is connected to one of the diodes, itself connected to one of the filters.

Let us consider signals $s_1(t)$ and $s_2(t)$, respectively, applied to electrooptic modulators 3' and 3'', respectively, by antennas A1 and A2, respectively.
35 In this example, the set of photodiodes receiving the superimposed light beams deliver the sum of the electrical signals $s_1(t) + s_2(t)$ carried by the reference light beam and the light beam coming from the retarder 4'', respectively. The diodes operate in a

nonlinear regime so as to be sensitive to the square of the sum of the electrical signals above. At the output of each filter are obtained signals representative of the product $s_1(t)s_2(t)$ retarded by a delay which is
5 dependant on the sub-beam received by the filter in question. The maximum value of these "products", that is to say the aforementioned maximum light intensities, makes it possible to obtain the arrival time of the wave on the antenna A2 connected to the modulator 3"
10 with respect to its arrival time on the antenna A1 connected to the modulator 3'.

Should, for example, the differential measurement be carried out on the basis of two signals over two different periods, respectively, the
15 measurement obtained may be negative. Adjustment of the analysis device will then be carried out such that the region corresponding to a zero-propagation-time differential measurement is defined in order to show all the possible measurements (for example, situated in
20 the central region of the analysis device 6).

Figure 2(b) is a partial diagram which is more detailed than that of figure 1(b). It relates to an exemplary embodiment of the differential measurer with a retarder 4" comprising a dispersive fiber which has a
25 monotonic index variation within the wavelength range of the source 11'.

The source device 1 comprises two sources: a monochromatic source 11 supplying a first light beam 2' and a broadband source 11' supplying a second light
30 beam 2" consisting of several wavelengths in the interval λ_1 to λ_n .

The first light beam 2' is modulated within the electrooptic modulator 3' by the electrical signal $s_1(t)$ emanating from the antenna A1 receiving the
35 electromagnetic wave H. The beam output from the modulator 3' then passes through a fiber, which is not wavelength-dispersive, before being collimated by the collimator L1 represented by two lenses.

The second light beam 2" is modulated within a second electrooptic modulator 3" by a second electrical signal $s_2(t)$ emanating from a second antenna A2 receiving the same electromagnetic wave H. The beam
5 output from the modulator 3" passes through a wavelength-dispersive fiber 4" before being collimated by the collimator L2 represented by two lenses. The dispersive fiber 4" induces a delay τ_i of the sub-beam of wavelength λ_i depending on the wavelength λ_i of this
10 sub-beam. This function $\tau_i = f(\lambda_i)$ may be continuous or discontinuous. The second light beam output from the collimator L2 is reflected from a grating for angular diffraction at wavelength λ . It is then focused using a lens within the superposition device 5 before being
15 received by the analysis device 6 comprising an array of photodetectors. Each region of the array 6 corresponding [sic] to a beam of wavelength given by the angular diffraction grating of the superposition device 5.

20 The array of the analysis device 6 also receives the first beam coming from the collimator L1. The region of maximum light intensity of the array of the analysis device 6 then corresponds to a given wavelength λ_i , itself corresponding to a known delay τ_i
25 depending on the dispersive fiber 4" used. This delay τ_i is the time taken by the wave H having reached the antenna A2 to arrive at the antenna A1.

Figure 3 shows a perspective view of an exemplary embodiment of a variant of the differential
30 measurer of the propagation time of a wave using a tunable laser as second source 11. within the source device 1.

The second light beam coming from the second modulator 3" comprises wavelengths λ_1 to λ_m . There are
35 then several possible variants.

In the first, the second beam is collimated, then it passes through the semireflecting mirror before being reflected from a retroreflector comprising, for example, a grating etched with lines of different

itches adapted to each wavelength λ_i of the tunable laser. A variation in wavelength leads to a variation in the angle of reflection from the grating of the retarder 4". The sub-beams of wavelength λ_i are then
5 reflected at an angle θ_i depending on their wavelength. The use of a collimator is then necessary before sampling by the spatial modulator E.

Figure 3 corresponds to another variant, in which each of the sub-beams of given wavelength λ_i
10 passes through a given part L2i of the convergent lens L2. Then the whole beam passes through the semireflecting mirror 5 before being reflected from the retroreflector of the retarder 4" which leads to delays τ_i depending on the wavelength λ_i of the sub-beam which
15 it reflects. The delays thus obtained can be better matched to the measurement to be carried out. The retroreflector comprises, for example, a grating etched with lines of different pitches matched to each wavelength λ_i of the tunable laser.

20 The diagram of Figure 4 is an example of a device for identifying the propagation direction of a wave according to the invention. This device consists of two measurers having part of the source device 1 supplying the first beam 2" and the antenna A1
25 supplying the electrical signal $s_1(t)$ which modulates this first beam 2' in common. The first measurer is drawn in solid line and the second measurer, in its own part, is drawn in dotted line and has its elements referenced by an "a". Having two measurers one above
30 the other, as shown in the figure, makes it possible to propose compact equipment but this provision is in no way indispensable to the operation of each of the two measurers.

This device, designed to be coupled to three
35 antennas, is used for waves whose wavefronts may be considered as plane since they come from a relatively distant source of the device for identifying the propagation direction of the wave. Generally, the devices for identifying the propagation direction of a

wave according to the invention comprise n measurers where n is an integer at least equal to two, a common part within the source device supplying a monochromatic light beam and receiving two modulation signals, one of which comes from a common antenna called the reference antenna.

Let us consider, for example, the case where the source device 1 comprises a monochromatic source 11 and an optical splitter 12. This optical splitter 12 then supplies three light beams.

The first light beam 2' common to the two measurers is modulated within the electrooptic modulator 3' itself also common to the two measurers by the electrical signal $s_1(t)$ emanating from the common antenna A1 receiving an electromagnetic wave H . The resultant beam then passes through a collimator L1, is then reflected from a mirror M1, then passes through a spatial modulator C1, the role of which has been specified during the description of Figure 2(a). This beam then passes through the semireflecting mirrors 5 and 5_a.

As for the second beam 2" and the third beam 2"_a they are modulated within electrooptic modulators 3" and 3"_a, respectively, by electrical signals $s_2(t)$ and $s_3(t)$, respectively, emanating from antennas A2 and A3, respectively, receiving the same electromagnetic wave. The beams thus obtained then pass through the collimators L2 and L2_a, then the semireflecting mirrors 5 and 5_a, respectively, before being reflected on the retarders 4" and 4"_a comprising, for example, a retroreflector. The beams reflected by the retarders 4" and 4"_a are reflected from semireflecting mirrors 5 and 5_a, respectively and are superimposed on the first beam.

The beams resulting from the superposition of the second and third beams with the first beam pass through the spatial modulators E and E_a, respectively, carrying out the sampling, as described during the description of figure 2(a), before being received by

analysis devices 6 and 6_a, respectively, which seek the two maximum intensity light sub-beams within the two light beams resulting from the superposition. Each of these sub-beams corresponds to a delay equal to the
5 time interval between the arrival of the wave H on one of the antennas A2 or A3 and on the antenna A1.

Figure 5 is a perspective view of an exemplary embodiment of collimators L2 and L2_a, of superposition devices 5 and 5_a and of retarders 4" and 4a" of a
10 device for identifying the propagation of a wave described in figure 3 where the source device 1 comprises a monochromatic source 11 and an optical splitter 12 supplying three light beams.

The light beams come from modulators 3" and
15 3a", respectively via divergent optical fibers F• and Fa", respectively. A convergent lens (for example, a cylindrical lens) transforms these two divergent beams into two beams with parallel rays. The output of the fiber F• and the upper part, for example, of the
20 convergent lens form the collimator L2 in the same way that the output of the fiber Fa" and the lower part, for example, of the convergent lens form the collimator L2_a.

Another exemplary embodiment of collimators is
25 the use of two different lenses mounted on the same vertical support, such that the top lens is part of the collimator L2 and the bottom lens is part of the collimator L2_a.

Next, the collimated light beams pass through
30 the top part 5 and the bottom part 5_a, respectively, of the semireflecting mirror before being reflected from the top part 4" and the bottom part 4a", respectively of a retroreflector. The retroreflector 4", 4a" comprises, for example, mirrors arranged in dihedrons
35 so as to reflect the light in the direction opposite to the direction of the arrival of this light. Another exemplary embodiment is a retroreflector comprising several layers of materials of different indices arranged in a plane and placed on a mirror.

The beams coming from the retroreflector are reflected on the semireflecting mirror from parts 5 and 5_a, respectively, in order to be directed toward sampling elements E and E_a and the analysis devices 6 and 6_a, respectively, described above.

A possible variant of the retarder is to combine, within the retarder 4", the retroreflector with reflecting mirrors so as to make the beams pass several times onto the retroreflector, thereby making it possible to multiply the delays.

A possible variant of the differential measurer and of the device for identifying the propagation direction of a wave consists in removing one or the other, or even both, of the spatial modulators C1 and E since they are not necessary for their proper operation.

A variant of the device for identifying the propagation direction of a wave comprising [sic] the use of a single differential measurer comprising three antennas A1, A2 and A3. The first antenna A1 receives an electrical signal which modulates the first light beam 2'. A switch makes it possible to choose the electrical signal of the second or of the third antenna (A2 or A3) in order to modulate the second electrical [sic] beam. The identifying device will therefore measure successively the time taken for the wave H having reached the antenna A2 to arrive at the antenna A1, then the time taken by the wave H having reached the antenna A3 to arrive at the antenna A1.

CLAIMS

1. Differential measurer of the propagation time of a wave, for measuring the interval between the arrival time of the same wave on two antennas situated in different locations, characterized in that it comprises in series a source device (1) supplying a first light beam (2') and at least a second light beam (2"), a device (5) for superimposing light beams, a device (6) for analyzing the light intensity level, and in that the source device (1) is connected to the superposition device (5) by a first path of the first light beam (2') which comprises a first electrooptic modulator (3') comprising a modulation input coupled to a first antenna (A1) and by a second path of the second light beam (2") which comprises in series a second electrooptic modulator (3") comprising a modulation input coupled to a second antenna (A2) and a retarder (4").
2. Differential measurer according to the preceding claim, characterized in that the source device (1) comprises in series a monochromatic source (11) and an optical splitter (12) supplying the said beams (2') and (2").
3. Differential measurer according to claim (1), characterized in that the source device (1) comprises at least two sources (11') and (11.), each one supplying one of the said light beams (2') and (2").
4. Differential measurer according to claim 3, characterized in that the said sources (11') and (11.) are monochromatic sources.
5. Differential measurer according to claim 3, characterized in that the first source (11') is a monochromatic source and the second source (11.) is a wavelength-tunable laser.
6. Differential measurer according to one of the preceding claims, characterized in that the first light path comprises an additional retarder (4'), the input of which is coupled to the output of the first

electrooptic modulator (3') generating a reference delay τ_m .

7. Differential measurer according to the preceding claim, characterized in that the duration of
5 the delay τ_m is equal to that of the median delay applied to the beam emanating from the modulator (3") by the retarder (4").

8. Differential measurer according to one of the preceding claims, characterized in that the retarder
10 (4") generates all the delays.

9. Differential measurer according to one of the preceding claims, characterized in that the retarder (4") is a spatial retarder which makes the second light beam (2") undergo delays which vary spatially in either
15 a continuous or discontinuous manner.

10. Differential measurer according to claim 9, characterized in that the spatial retarder comprises a retroreflector.

11. Differential measurer according to either of
20 claims 9 and 10, characterized in that the superposition device (5) comprises a semireflecting mirror such that it superimposes the said light beams (2') and (2"), the first beam (2') comes from the electrooptic modulator (3') and passes through the
25 semireflecting mirror, the second beam (2") comes from the retarder (4") and is reflected by the semireflecting mirror in the same direction as the first light beam.

12. Differential measurer according to one of
30 claims 9 to 11, characterized in that it comprises, on the first path (2'), between the electrooptic modulator (3') and the superposition device (5), a spatial light modulator (C1), the role of which is to compensate, by balancing, for the optical defects of the two paths.

35 13. Differential measurer according to one of claims 9 to 12, characterized in that it comprises, between the superposition device (5) and the analysis device (6), a spatial modulator (E) the role of which

is that of a shutter in order to carry out spatial sampling.

14. Differential measurer according to one of claims 1 to 8, characterized in that the retarder (4")
5 is a wavelength-dispersive fiber.

15. Differential measurer according to claim 14, characterized in that it comprises a fiber (4'), which is not wavelength-dispersive, on the first path (2') between the electrooptic modulator (3') and the
10 superposition device (5).

16. Differential measurer according to one of claims 14 or 15, characterized in that the superposition device (5) comprises, on the second light path (2"), a grating for angular wavelength diffraction
15 followed by a focusing device in order to direct this second light beam onto a specific region which is dependent on the wavelength of this second beam (2") of the analysis device (6) illuminated by the first light beam (2').

20 17. Method of differential measurement of the propagation time of a wave, for measuring the interval between the arrival time of the same wave on two antennas situated in different locations, characterized in that a first light beam (2') is modulated by the
25 information emanating from the first antenna (A1), then superimposed on the second light beam (2") which has been modulated by the information emanating from the second antenna (A2), then retarded by the sub-beam for different durations, such that the beam obtained by
30 this superposition has a more intense part corresponding to a sub-beam of known actual delay and equal to the said measurement.

18. Device for identifying the propagation direction of a wave, characterized in that it comprises
35 n (where n is an integer at least equal to two) differential measurers according to one of claims 1 to 16, having part of the source device (1) supplying the first light beam (2') and one of the antennas (A1) in common.

19. Device for identifying the propagation
direction of a wave according to claim 18,
characterized in that the monochromatic source (11) and
the optical splitter (12) of the source device (1) are
5 common to all the n measurers and in that the optical
splitter (12) supplies $n + 1$ light beams, the first of
the said beams being supplied to all of the
 n measurers, the n other beams being distributed one
per measurer, and in that the first light path common
10 to the n measurers comprises a first electrooptic
modulator (3') common to the n measurers comprising a
modulation input coupled to the said antenna (A1)
common to the n measurers.

20. Device for identifying the propagation
15 direction of a wave according to claim 18,
characterized in that the source device comprises $n + 1$
sources, one source common to all the n measurers and n
sources, one per differential measurer and in that the
first light path common to the n measurers comprises a
20 first electrooptic modulator (3') common to the n
measurers comprising a modulation input coupled to the
said antenna (A1) common to the n measurers.

21. Device for identifying the propagation
direction of a wave according to claim 18,
25 characterized in that the source device comprises two
sources common to all the n measurers; in that the
first light path common to the n measurers comprises a
first electrooptic modulator (3') common to the n
measurers comprising a modulation input coupled to the
30 said antenna (A1) common to the n measurers, and in
that the second source is a tunable laser common to all
the n measurers, a given wavelength of the laser being
assigned to a given measurer.

22. Method for identifying the propagation
35 direction of a wave, characterized in that the
direction is calculated by measuring, according to
claim 17, the interval between the arrival time of a
wave on a first antenna called a reference antenna (A1)

and the arrival times of the same wave on other antennas.