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**Datasheet for the decision
of 22 January 2008**

Case Number: T 1023/07 - 3.5.05

Application Number: 03735438.8

Publication Number: 1512258

IPC: H04L 27/26

Language of the proceedings: EN

Title of invention:

Apparatus and method for estimating a channel in a multiple
input transmission system

Applicant:

NTT DoCoMo, Inc.

Opponent:

-

Headword:

Channel estimation/NTT DOCOMO

Relevant legal provisions:

EPC Art. 84, 123(2)

Keyword:

"Clarity - after amendment (yes)"

Decisions cited:

-

Catchword:

-



Case Number: T 1023/07 - 3.5.05

D E C I S I O N
of the Technical Board of Appeal 3.5.05
of 22 January 2008

Appellant:

NTT DoCoMo, Inc.
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Representative:

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Patentanwälte
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Decision under appeal:

Decision of the Examining Division of the
European Patent Office posted 13 December 2006
refusing European application No. 03735438.8
pursuant to Article 97(1) EPC (1973).

Composition of the Board:

Chairman: D. H. Rees
Members: A. Ritzka
R. Moufang

Summary of Facts and Submissions

I. This appeal is against the decision of the examining division dispatched 13 December 2006, refusing European patent application No. 03 735 438.8 on the ground that the application did not satisfy the requirements of Article 84 EPC. The examining division stated at the end of the reasons for the decision that it did not seem possible to assess the novelty of the claims for DE and GB with respect to document

D2: WO 2004/073276 A,

in view of the major unclarities that they contained.

II. Notice of appeal and the statement of grounds of appeal were filed on 20 February 2007. Amended sets of claims 1 to 11 for the designated states DE and GB and for FR were filed with the notice of appeal. An auxiliary request for oral proceedings was made. The appellant failed to pay the appeal fee on time, however.

III. A request for restitutio in integrum into the term for paying the appeal fee in accordance with Article 108 EPC, together with facts and evidence supporting the request, was submitted and the appeal fee paid on 20 April 2007. The board decided to re-establish the appellant in its rights in the board's interlocutory decision of 31 July 2007.

IV. The board issued an invitation to oral proceedings accompanied by a communication. In the communication the board invited the appellant to specify the further documents of its request and expressed its preliminary

view of the allowability of the new claims. Replacing the term "multiplier" in the original claims by "copy provider" in the claims filed with the notice of appeal was objected to under Article 123(2) EPC. The use of the term "copy provider" was unclear, and claim 1 for FR, and claims 6, 8 and 10 of both versions were objected to under Article 84 EPC for additional reasons. As the decision of the first instance was only based on the reason that claim 1 lacked clarity, it was stated that should the appeal be granted it was likely that the case would be remitted. The board made an additional comment with respect to the discussion which had taken place during examination of the novelty of claims 1 and 9 for DE and GB having regard to the disclosure of D2.

V. With its letter submitted 11 December 2007, in response to the communication, the appellant filed new sets of claims for DE and GB and for FR and amended pages of the description of a main request and an auxiliary request and requested that a patent be granted based on the documents of this main request or auxiliary request. In case the board felt that it was not in a position to decide on novelty and inventive step it was requested to remit the case to the department of first instance.

VI. During oral proceedings which took place as scheduled on 22 January 2008, the appellant filed revised claims 1 to 11 for DE and GB to replace the corresponding claims of the main request and requested that the case be remitted to the department of first instance for further prosecution on this basis.

VII. Claim 1 for DE and GB of the main request reads as follows:

"Apparatus for estimating a channel from a transmitting point to a receiving point in an environment, in which at least two transmitting points spaced apart from each other are present, each transmitting point having associated therewith a pilot sequence, wherein the pilot sequences are different from each other, comprising:

a provider (107) for providing an input signal, the input signal including a superposition of signals from the transmitting points;

characterized by

a multiplier (109) for providing a number of copies of the input signal, the number of copies being equal to the number of transmitting points;

for each copy of the input signal, a transformer (115, 117; 317, 319) for transforming a signal derived from the copy to obtain a transformed signal, the transformer (115, 117; 317, 319) being operative to apply a transform algorithm, which is based on a Fourier transform; and

for each transformed signal, an extractor (119, 121) extracting a portion of the transformed signal to obtain an estimated channel impulse response for the channel to be estimated, wherein each extractor (119, 121) is operative to receive a transformed signal only from an associated transformer (115, 117; 317, 319);

wherein a pre-multiplier (202, 208; 301, 309) is connected between the multiplier (109) and at least one transformer (115, 117; 317, 319) to generate the signal derived from the copy, the pre-multiplier (202, 208; 301, 309) being operative to pre-multiply a copy of the input signal by a complex conjugate version of a pilot sequence associated with a transmitting point defining the channel to be estimated to obtain a pre-multiplied input signal."

Claim 8 for DE and GB of the main request reads as follows:

"Apparatus for estimating a channel from a transmitting point to a receiving point in an environment, in which at least two transmitting points spaced apart from each other are present, each transmitting point having associated therewith a pilot sequence, wherein the pilot sequences are different from each other, comprising:

a provider (107) for providing an input signal, the input signal including a superposition of signals from the transmitting points;

characterized by

a transformer for transforming the input signal or a copy of the input signal to obtain a transformed signal, the transformer being operative to apply a transform algorithm for transforming from the frequency domain to the time domain, the transform algorithm being an

inverse Fourier transform, an inverse discrete Fourier transform or an inverse fast Fourier transform;

a multiplier (109) for providing a number of copies of the transformed signal, the number of copies being equal to the number of transmitting points;

for each copy of the transformed signal, an extractor (119, 121) for extracting a portion of the copy of the transformed signal to obtain an estimated channel impulse response for the channel to be estimated."

Claims 9 and 10 for DE and GB of the main request are method claims corresponding to apparatus claims 1 and 8 for DE and GB of the main request, respectively.

Claim 1 for FR of the main request reads as follows:

"Apparatus for estimating a channel from a transmitting point to a receiving point in an environment, in which at least two transmitting points spaced apart from each other are present, each transmitting point having associated therewith a pilot sequence, wherein the pilot sequences are different from each other, comprising:

a provider (107) for providing an input signal, the input signal including a superposition of signals from the transmitting points;

characterized by

a multiplier (109) for providing a number of copies of the input signal, the number of copies being equal to the number of transmitting points;

for each copy of the input signal, a transformer (115, 117; 317, 319) for transforming the copy or a signal derived from the copy to obtain a transformed signal, the transformer (115, 117; 317, 319) being operative to apply a transform algorithm, which is based on a Fourier transform, wherein the signal derived from the copy is obtained by pre-multiplying the copy by a complex conjugate version of a pilot sequence associated with a transmitting point defining the channel to be estimated; and

for each transformed signal, an extractor (119, 121) extracting a portion of the transformed signal to obtain an estimated channel impulse response for the channel to be estimated, wherein each extractor (119, 121) is operative to receive a transformed signal only from an associated transformer (115, 117; 317, 319)."

Claim 8 for FR of the main request reads as follows:

"Apparatus for estimating a channel from a transmitting point to a receiving point in an environment, in which at least two transmitting points spaced apart from each other are present, each transmitting point having associated therewith a pilot sequence, wherein the pilot sequences are different from each other, comprising:

a provider (107) for providing an input signal, the input signal including a superposition of signals from the transmitting points;

characterized by

a transformer for transforming the input signal or a copy of the input signal to obtain a transformed signal, the transformer being operative to apply a transform algorithm, which is based on a Fourier transform;

a multiplier (109) for providing a number of copies of the transformed signal, the number of copies being equal to the number of transmitting points;

for each copy of the transformed signal, an extractor (119, 121) extracting a portion of the copy of the transformed signal to obtain an estimated channel impulse response for the channel to be estimated."

Claims 9 and 10 for FR of the main request are method claims corresponding to apparatus claims 1 and 8 for FR of the main request, respectively.

Reasons for the Decision

1. *Main request for DE and GB*

1.1 Claim 1

1.1.1 Claim 1 corresponds to a combination of claims 1 and 7 as originally filed except for the expression "characterized by" and for the amendment "at least one"

in the last feature between "multiplier and" and "transformer". According to claim 1 as published, "for each copy of the input signal, a transformer ..." is required, i.e. a plurality of transformers is disclosed. In addition on page 22 of the description between lines 8 and 16 the embodiment of Fig. 2 is described as being distinguished from that of Fig. 1 by the inclusion of "a pre-multiplier 201 having an input connected to the output 111 of the multiplier 109 and an output 203 connected to the transformer 115", i.e. a single pre-multiplier, although the figure actually shows a pre-multiplier in each of the two branches consisting inter alia of a multiplier output and a transformer. However, in case that the pilot sequence is an all one sequence or if the coefficients of the pilot sequence vary only within a small range, the pre-multiplier may be bypassed by the input signal provided by the output to the transformer, see page 23, lines 17 to 22. The skilled person would understand that there may be branches including a pre-multiplier and different branches without pre-multiplier. As the embodiment of Fig. 2 distinguishes from that of Fig. 1 by the inclusion of "a pre-multiplier" (see above), the disclosure does encompass the case where there is only a pre-multiplier in one of the branches. Hence the feature as claimed, namely "a pre-multiplier is connected between the multiplier and at least one transformer," is disclosed in its full range by the application as originally filed and claim 1 fulfils the provisions of Article 123(2) EPC.

- 1.1.1.2 The apparatus of claim 1 includes "a provider (107) for providing an input signal". The skilled person would understand this feature as (a) giving a functional

definition of the feature and (b) naming the corresponding element. It would further be clear to the skilled person whether a particular element fulfilled that functional definition in any particular apparatus. This feature is therefore clear. In addition, according to page 16, last paragraph of the description as published the output of a receive antenna is connected to a provider which has an output to a multiplier. The skilled person would understand that the provider forwards any signal present at the antenna's output to the multiplier. Thus the term "provider" and its functional definition in the claim are supported by the description.

- 1.1.3 The apparatus of claim 1 further includes "a multiplier for providing a number of copies of the input signal". The skilled person would understand this feature too as (a) giving a functional definition of the feature and (b) naming the corresponding element. The verb "to multiply" includes amongst its common meanings the idea of replication and thus the skilled person would understand that the name "multiplier" can reasonably be used for a device which provides copies. It is true that a more common meaning for the term "multiplier" in the general field of digital electronics is a device which arithmetically multiplies numbers, but here the presence of the functional definition in the claim makes clear what is meant. As a result it would further be clear to the skilled person whether a particular element fulfilled the functional definition in any particular apparatus. This feature is therefore clear. Moreover the use of this name and its functional definition are supported by the description (page 16, final paragraph).

1.1.4 Thus, claim 1 complies with the provisions of Article 84 EPC.

1.2 Claim 8

1.2.1 Claim 8 corresponds to claim 9 as originally filed except for the term "characterized by", and for replacing "which is based on a Fourier transform" by "being an inverse Fourier transform, an inverse discrete Fourier transform or an inverse fast Fourier transform" and for adding "for transforming from the frequency domain to the time domain". The embodiment claimed by claim 8 is supported by the paragraph bridging pages 21 and 22 and the description of figure 1 at pages 16 to 21. It is disclosed at the last paragraph of page 18 with reference to figure 1 that the transformers may be operative to perform inter alia an inverse Fourier transform, an inverse discrete Fourier transform or an inverse fast Fourier transform.

1.2.2 It is a generally accepted convention in the art that the expression "Fourier transform" is used for a transform from the time domain to the frequency domain and the expression "inverse Fourier transform" for a transform from the frequency domain to the time domain. Applying a transform algorithm which is an inverse Fourier transform, an inverse discrete Fourier transform or an inverse fast Fourier transform therefore implies a transform from the frequency domain to the time domain.

1.2.3 Thus, claim 8 fulfils the provisions of Article 123(2) EPC.

1.2.4 With respect to the provider and the multiplier included in the apparatus of claim 8 the comments made in points 1.1.2 and 1.1.3 above apply.

1.2.5 Thus, claim 8 complies with the provisions of Article 84 EPC.

1.3 Claims 9 and 10

Claims 9 and 10 are method claims corresponding to the apparatus claims 1 and 8, respectively. They include the corresponding amendments. The comments made in points 1.1 and 1.2 with respect to claims 1 and 8 apply respectively.

2. *Main request for FR*

2.1 Claim 1

2.1.1 Claim 1 corresponds to claim 1 as originally filed except for the further limitation that the signal derived from the copy is obtained by pre-multiplying the copy by a complex conjugate version of a pilot sequence associated with a transmitting point defining the channel to be estimated. This addition is supported by the description page 23, first and second paragraph. Moreover, it corresponds to claim 7 as originally filed without mentioning the pre-multiplier explicitly. However, the skilled person would understand that pre-multiplying implies a pre-multiplier. Thus, claim 1 complies with the provisions of Article 123(2) EPC.

2.1.2 With respect to the provider and the multiplier included in the apparatus of claim 1 the comments made in points 1.1.2 and 1.1.3 above apply.

2.1.3 Thus, claim 1 complies with the provisions of Article 84 EPC.

2.2 Claim 8

2.2.1 Claim 8 corresponds to claim 8 as originally filed. Thus, it complies with the provisions of Article 123(2) EPC.

2.2.2 With respect to the provider and the multiplier included in the apparatus of claim 8 the comments made in points 1.1.2 and 1.1.3 above apply.

2.2.3 Thus, claim 8 complies with the provisions of Article 84 EPC.

2.3 Claims 9 and 10

Claims 9 and 10 are method claims corresponding to the apparatus claims 1 and 8, respectively. They include the corresponding amendments. The comments made in points 2.1 and 2.2 with respect to claims 1 and 8 apply respectively.

3. *Auxiliary request*

In view of the board's decision it is not necessary to deal with the auxiliary request.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the department of first instance for further prosecution on the basis of the documents of the main request as submitted with letter dated 11 December 2007 and amended in the oral proceedings.

The Registrar:

The Chairman:

K. Götz

D. H. Rees