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Datasheet for the decision of 25 April 2008

Case Number: T 0004/06 - 3.5.03

Application Number: 02029036.7

Publication Number: 1361669

IPC: H04B 1/707

Language of the proceedings: EN

Title of invention:
Noise elimination method and apparatus

Applicant:
FUJITSU LIMITED

Opponent:
-

Headword:
Noise elimination/FUJITSU

Relevant legal provisions:
EPC Art. 83

Relevant legal provisions (EPC 1973):
-

Keyword:
"Disclosure - sufficient (no)"

Decisions cited:
-

Catchword:
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Case Number: T 0004/06 - 3.5.03

D E C I S I O N
of the Technical Board of Appeal 3.5.03
of 25 April 2008

Appellant:	FUJITSU LIMITED 1-1, Kamikodanaka 4-chome Nakahara-ku Kawasaki-shi Kanagawa 211-8588 (JP)
Representative:	HOFFMANN EITLE Patent- und Rechtsanwälte Arabellastrasse 4 D-81925 München (DE)
Decision under appeal:	**Decision of the examining division of the European Patent Office posted 1 June 2005 refusing European application No. 02029036.7 pursuant to Article 97(1) EPC 1973.**

Composition of the Board:

Chairman: A. S. Clelland
Members: F. van der Voort
R. Moufang

Summary of Facts and Submissions

I. This appeal is against the decision of the examining division refusing European patent application No. 02029036.7 (publication number EP 1 361 669 A) on the ground that the application did not meet the requirements of Article 83 EPC.

II. With the statement of grounds of appeal, dated 7 October 2005, the appellant submitted claims of a first auxiliary request together with amended description pages. The main request remained the main request dated 14 April 2005 and decided on by the examining division. The appellant requested that the decision of the examining division be set aside "in order that the application may proceed further". Arguments in support were submitted and oral proceedings were conditionally requested.

III. The appellant was summoned to oral proceedings. In a communication accompanying the summons, the board raised, without prejudice to its final decision, objections under Articles 83 and 84 EPC.

IV. In response to the board's communication, the appellant filed, with a letter dated 25 March 2008, claims of a second and a third auxiliary request and presented arguments in support of these requests.

V. Oral proceedings were held on 25 April 2008. The appellant requested that the decision under appeal be set aside and that a patent be granted on the basis of claims 1 to 10 of the main request dated 14 April 2005 or, in the alternative, claims 1 to 10 of the first auxiliary request dated 7 October 2005, or claims 1 to 10 of the second auxiliary request or claims 1 to 9 of the third auxiliary request, both dated 25 March 2008. At the end of the oral proceedings the board's decision was announced.

VI. Claim 1 of the main request reads as follows:

"A noise elimination method, comprising the step of:
receiving a transmitted spread spectrum modulated signal including a noise component;
and characterized by the steps of:
generating a correlation (90) of the received modulated signal to a spread spectrum code;
extracting the noise component (91) from the received modulated signal other than at a signal point where the correlation becomes the maximum;
predicting the noise component (93) at the signal point by performing interpolation prediction based on the extracted noise component; and
removing the noise component (92) from the received modulated signal at the signal point based on the predicted noise component."

Claim 1 of the first auxiliary request reads as follows:

"A noise elimination method, comprising the step of:
receiving a transmitted spread spectrum modulated signal including a noise component;
and characterized by the steps of:
generating a correlation (90) of the received modulated signal to a spread spectrum code whereby to demodulate the received signal, the correlation being a maximum at first points of the demodulated signal;

extracting the noise component (91) from the demodulated signal at second points, which second points are points other than where the correlation becomes the maximum;

predicting the noise component (92) at the first points by performing interpolation prediction based on the extracted noise component; and

removing the noise component (93) from the demodulated signal at the first points based on the predicted noise component."

Claim 1 of the second auxiliary request reads as follows:

"A noise elimination method, comprising the step of:

receiving a transmitted spread spectrum modulated signal including a noise component;

and characterized by the steps of:

generating a correlation (90) of the received modulated signal to a spread spectrum code whereby to demodulate the received signal and produce a demodulated signal, having data signals with overlapping noise components at signal points on a time axis and signals comprising only noise components at zero points on the time axis, the data signals being at signal points corresponding to maximum correlation with the spread spectrum code;

extracting the noise component (91) from the signals with noise only components at the zero points;

predicting the noise component (92) of the data signals with overlapping noise components at the signal points by performing interpolation prediction based on the extracted noise component; and

removing the noise component (93) from the data signals with overlapping noise components at the signal points based on the predicted noise component."

Claim 1 of the third auxiliary request differs from claim 1 of the second auxiliary request in including the additional feature of "the correlation being generated by using a correlating filter (11)" and the additional step of "setting zero at the signal points of the data signals with overlapping noise components of the demodulated signal".

Reasons for the Decision

1. *Article 83 EPC*

1.1 The application does not meet the requirements of Article 83 EPC for the following reasons.

1.2 The present application relates to a noise elimination method for eliminating noise in received data. With reference to Figs 21 to 23, a conventional noise elimination method is described. According to this conventional method, a data signal to be transmitted, which is not a spread spectrum signal, is pre-processed at the transmitter in that in between signal points S1, ..., S8 on a time axis, in which these signal points correspond to the data signal, zero-points are inserted (see Fig. 22A). The signal is subsequently transmitted via a transmission path, e.g. a transmission line of a power-line-carrier communication system (see Fig. 18), and is received as a signal which is affected by noise, i.e. each of the signal points and zero-points now additionally include a noise component. At the receiver, a zero-point thinning unit 155 (see Fig. 21) extracts from the received signal the amplitudes at the zero-points. On the basis of these extracted amplitudes at the zero-points, the noise at those points in time which correspond to the signal points of the received signal is determined by means of an interpolation prediction unit 156 (see Figs 21 and 22C). The composed signal consisting of the amplitudes at the zero-points and the predicted noise components at the signal points is subsequently subtracted from the received signal (noise elimination unit 154 in Fig. 21), resulting in a signal (Fig. 22D) in which noise at both the zero-points and the signal points has been eliminated.

1.3 The present invention as defined in claim 1 of each of the requests relates to a method of eliminating noise in a spread spectrum modulated signal.

1.4 According to the present invention, there is no zero-point insertion at the transmitter, see the description, paragraph [0064] of the application as published ("Unlike the conventional noise elimination function, even if the zero-point insertion on the transmitter section is not performed, the large-amplitude noise included in the received data signal point can be removed."), paragraph [0077] ("In the transmitter section of the present embodiment, the zero is not inserted to the transmitting data signal like the conventional noise elimination function shown in Fig. 21."), and paragraph [0177] ("The conventional noise elimination function of FIG. 21 inserts the zero point to the transmitting data signal. However, the noise elimination unit of the present invention does not insert the zero point to the transmitting data signal. Even if the zero point insertion is not performed to the transmitting data signal, it can safely remove the noise from the received data signal in which the large-amplitude noise is included by performing the operation similar to the zero-point insertion.").

In line with the description, claim 1 of each one of the requests does not require that zero-points are inserted in the signal to be transmitted. This is also in accordance with the appellant's intention (see the statement of grounds, page 2, 4th paragraph, page 3, 2nd paragraph, page 4, 3rd paragraph, page 9, 2nd paragraph, page 11, 4th paragraph, and page 15, 4th paragraph, and the letter dated 25 March 2008 (page 3, 2nd and 3rd paragraphs). The only requirement in claim 1 of each one of the requests as to the properties of the signal to be transmitted is that it is a spread spectrum modulated signal.

1.5 According to the present invention, instead of inserting zero-points at the transmitter, zeros are inserted at the receiver. More specifically, see paragraph [0063], at the receiver a correlating filter unit provides a correlation of the spread spectrum (SS) modulation signal and the SS code and sets "the zero point to the signal except for the signal point where the correlation becomes the maximum". As illustrated in Fig. 11, which is a block diagram of the noise elimination unit 14 of Figs 1, 8 or 9 (see paragraph [0142]) and Fig. 14, the signal applied to the respective interpolation prediction units 73 and 92 is controlled by a thinning unit 72, 91 which outputs either the output signal of the correlating-filter unit 11, 90 or, if a maximum correlation is achieved, a zero (see paragraphs [0146] and [0172]). The subsequent noise elimination is said to be essentially the same as described in relation to the above-mentioned conventional noise elimination method (see paragraph [0148]).

Claim 1 of each of the requests accordingly specifies the step of "extracting the noise component (91) from the received modulated signal other than at a signal point where the correlation becomes the maximum" (main request), "extracting the noise component (91) from the demodulated signal at second points, which second points are points other than where the correlation becomes the maximum" (first auxiliary request), and "extracting the noise component (91) from the signals with noise only components at the zero points", in which the data signals are "at signal points corresponding to maximum correlation with the spread spectrum code" (second and third auxiliary requests).

1.6 In the board's view, however, a "maximum correlation" does not represent a point in time of the received modulated signal or the demodulated signal as obtained from the, otherwise unspecified, transmitted spread spectrum modulated signal for the following reasons:

1.7 In the case of spread spectrum (SS) modulation, the encoded digital data signal is modulated by an SS code sequence in order to expand or spread the signal bandwidth (see also the present description, paragraphs [0012] to [0016], and Figs 19A-D and 20). At the receiver, the received signal is despread by using the same SS code sequence generated at the receiver. As is well-known in the art, in order to successfully despread the received signal and thereby obtain the encoded digital data signal, it is necessary that the received SS code sequence and the receiver-generated SS code sequence are aligned or synchronized. The operation by which the phase of the receiver-generated SS code sequence is brought to within a fraction of a chip of the phase of the received code sequence is commonly referred to as code acquisition. For the code acquisition, a non-coherent correlator, which essentially consists of a multiplier and an integrator and which serially searches over the candidate offsets, is commonly used.

In the present application, the code acquisition is implemented by the correlating-filter unit 11, 90, see paragraphs [0082] and [0165] and Figs 1, 5, 6 and 14. More specifically, Fig. 6 shows the fifteen possible offsets in case of a code sequence consisting of fifteen chips in one frame. A maximum correlation is achieved for a (nearly) perfect synchronisation (i.e. a value 15 in Fig. 6). Once synchronisation is achieved, the correlating-filter unit 11 outputs a series of 1's and -1's, as determined by the digital data signal and the noise components (see paragraph [0083]), which is in line with the statement in the description that the output of the correlating-filter unit 11 is equivalent to the vector signal, i.e. the output of the demodulator 21 (see paragraphs [0097] and [0121] and Figs 1 and 2A).

The board therefore interprets the output signal of the correlating-filter unit as constituting the despread, demodulated digital signal, i.e. a series of -1's and 1's (ideally corresponding to 0's and 1's of the digital data signal) which is subsequently applied to the input of a noise elimination unit 14, see Figs 1, 8, 9 and 11. The appellant's statement that the correlating operation processing is equivalent to the known despreading processing for the received signal is fully in line with this interpretation (see the statement of grounds of appeal, page 4, fifth paragraph, and page 10, fourth paragraph).

However, it also follows from the above that the maximum correlation (i.e. the value 15 in Fig. 6) is not related to any specific point in time of the, otherwise unspecified, transmitted spread spectrum signal and, hence, of the received modulated signal as referred to in claim 1 of the main request or the demodulated signal as referred to in claim 1 of each one of the auxiliary requests. Hence, the points corresponding to a maximum correlation, i.e. minimum offset of SS codes, cannot be interpreted as being equivalent to the signal points S1, S2 in Fig. 22A, as stated in paragraph [0148] of the description. Consequently, it is unclear how the signal points, zero-points or second points as referred to in claim 1 of the various requests can be determined and be located in time in the modulated or demodulated signal, as is required in order to carry out the steps of extracting, predicting and removing of the noise component.

1.8 At the oral proceedings the appellant did not submit any arguments beyond those which were submitted with the statement of grounds and the letter in response to the board's communication.

In the statement of grounds the argumentation focuses on inconsistencies between the claims and the description as to the use of the terms "zero-points", "signal points", "zero-point signal", "zero insertion", and "zero-point insertion". These inconsistencies do not however affect the objection under Article 83 EPC as raised in the board's communication and in this decision. Further, in the statement of grounds of appeal the appellant refers to three European patent applications (EP 1 227 597 A, EP 1 303 094 A and EP 1 341 332 A). However, as pointed out by the appellant, these applications all relate to noise elimination methods in which zero-points are inserted in the data signal at the transmitter side, i.e. in the same way as in the conventional method as described in the present application.

In the letter in response to the board's communication, the appellant merely reiterates that according to the present invention no zeros are added to the spread spectrum signal to be transmitted and that "hence something else needs to be done in order that similar processing at the receiver to that employed in the conventional process can be carried out in order to eliminate the noise the spread spectrum signal picks up during transmission". However, apart from merely alleging that "the present application ... then specifically describes how these earlier methods can be applied to the spread spectrum case, which of necessity is somewhat different since zeros cannot be inserted", there is no explicit disclosure of or reference to any specific steps.

1.9 The board therefore concludes that, even when taking into account the common general knowledge of a person skilled in the art, at least in the case specifically addressed both in the application and by the appellant in the statement of grounds of appeal, in which no zero-points are inserted in the spread spectrum signal to be transmitted and in which the noise elimination is to be carried out through processing performed only at the receiver side, the noise elimination method of claim 1 of each one of the requests is not disclosed in the application as filed in a manner sufficiently clear and complete for it to be carried out by the person skilled in the art.

1.10 The application does not therefore meet the requirements of Article 83 EPC.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

D. Magliano A. S. Clelland