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Datasheet for the decision
of 7 July 2017

Case Number: T 2132/11 - 3.5.07
Application Number: 05819171.9
Publication Number: 1815600
IPC: H03M13/29
Language of the proceedings: EN

Title of invention:
Turbo-fountain code and its application for reliable wireless broadcast

Applicant:
Siemens Aktiengesellschaft

Headword:
Turbo-fountain code/SIEMENS

Relevant legal provisions:
EPC Art. 123(2), 84

Keyword:
Amendments - added subject-matter (yes)
Claims - clarity (no)
Case Number: T 2132/11 - 3.5.07

DECISION
of Technical Board of Appeal 3.5.07
of 7 July 2017

Appellant: Siemens Aktiengesellschaft
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Decision under appeal: Decision of the Examining Division of the European Patent Office posted on 20 July 2011 refusing European patent application No. 05819171.9 pursuant to Article 97(2) EPC.

Composition of the Board:
Chairman R. Mouvaf
Members: M. Jaedicke
P. San-Bento Furtado
Summary of Facts and Submissions

I. The applicant (appellant) appealed against the decision of the Examining Division refusing European patent application No. 05819171.9, filed as international application PCT/EP2005/056102 and published as WO 2006/056559 A1.

II. In the contested decision, the Examining Division held that the subject-matter of independent claims 1 and 5 of the sole request filed with letter of 20 April 2011 did not meet the requirements of Article 84 EPC.

III. With the statement of grounds of appeal, the appellant maintained the sole request underlying the contested decision and requested that the decision be set aside and that the appeal fee be at least partly reimbursed.

IV. In a communication under Article 15(1) RPBA accompanying a summons to oral proceedings, the Board inter alia expressed its provisional opinion that the subject-matter of claims 1 and 5 of the sole request was not clearly defined, lacked support and contained added subject-matter.

V. With a letter dated 12 June 2017, the appellant informed the Board that it would not be attending the oral proceedings. No arguments concerning the Board's provisional opinion were submitted.

VI. Oral proceedings were held as scheduled in the absence of the appellant. At the end of the oral proceedings, the chairman pronounced the Board's decision.
VII. Claim 1 of the sole request reads as follows:

"Apparatus for encoding a finite sequence \((u)\) of information symbols \((u_1, \ldots, u_k)\) into a potentially infinite sequence \((c)\) of code symbols \((c_1, c_2, c_3, \ldots)\), consisting of

- at least one concatenated encoder, which consists of at least two component encoders and of at least one interleaver and
- at least one further interleaver, whereby the interleavers form at least two interleaver branches and whereby the bits from each interleaver branch are mapped successively onto the sequence of code symbols."

Claim 5 reads as follows:

"Apparatus for decoding a potentially infinite sequence \((c)\) of received code symbols \((c_1, c_2, c_3, \ldots)\) into a finite sequence \((u)\) of information symbols \((u_1, \ldots, u_k)\), consisting of

- at least one concatenated decoder, which consists of at least two component decoders and of at least one interleaver, such as a parallel concatenated Turbo decoder, and
- at least one further interleaver, whereby the interleavers form at least two interleaver branches and whereby the received code symbols are distributed to different branches inversely \([sic]\) to the procedure at the output of the apparatus of the preceding claims."

The further claims are not relevant to the present decision.
VIII. The appellant's arguments relevant to the decision are discussed in detail below.

Reasons for the Decision

Admissibility of the appeal

1. The appeal complies with the provisions referred to in Rule 101 EPC and is therefore admissible.

The invention

2. The application relates to reliable wireless broadcasting (see section I of the description of the published application). While many types of multimedia data tolerate residual errors to some extent, some data (for example, files containing executable software) has to be downloaded error-free (see page 1, lines 9 to 15). For such error-free downloads via wireless broadcasts a channel code, denoted as fountain code, with potentially limitless redundancy (rateless code) was proposed.

3. According to the application, practical approximations of a digital fountain have been obtained in the prior art by the introduction of LT-Codes and Raptor codes (see page 2, first paragraph). Fountain codes offer advantages such as allowing multiple receivers to recover from different loss patterns or enabling an asynchronous start of data reception among the receivers (see page 3, third paragraph).

4. The application proposes as an alternative to the known approximations of a digital fountain a so-called turbo-fountain, which approximates a digital fountain by
applying turbo codes. The application describes two different realisations of turbo-fountains (TF) in section III, pages 6 to 11 and Figures 1 to 4: parallel turbo codes (TF-A) and multiple turbo codes (TF-B).

Added subject-matter - Article 123(2) EPC

5. Claim 1 is directed to an apparatus "for encoding a finite sequence (u) of information symbols (u_1, ..., u_k) into a potentially infinite sequence (c) of code symbols (c_1, c_2, c_3, ...)". The apparatus consists of the following features as itemised by the Board:
   (a) at least one concatenated encoder, which consists of
      (i) at least two component encoders and of
      (ii) at least one interleaver and
   (b) at least one further interleaver,
   (c) whereby the interleavers form at least two interleaver branches and
   (d) whereby the bits from each interleaver branch are mapped successively onto the sequence of code symbols.

6. The expression "at least one" means "one or more". Hence, in the Board's opinion, feature (b) specifies that the apparatus consists, in addition to the one or more interleavers defined in feature (a)(ii), of one or more further interleavers. It follows that an encoding apparatus comprising a total of two interleavers, one interleaver according to feature (a)(ii) and one further interleaver according to feature (b), is covered by the wording of claim 1. Feature (c) refers to "the interleavers" and hence to at least two interleavers, but does not specify whether it refers only to interleavers defined in feature (b) or also to the interleavers defined in feature (a)(ii). In the
case of an apparatus having only a single further interleaver according to feature (b), feature (c) has
to be interpreted as also referring to an interleaver
according to feature (a)(ii).

7. Features (c) and (d) were not present in the apparatus
of claim 1 as originally filed. Hence, it has to be
assessed whether there is a basis in the original
application for these features. In particular, there
must be a basis for adding feature (c) to original
claim 1, i.e. for an apparatus having at least two
interleaver branches formed by two interleavers, one
according to feature (b) and one according to
feature (a)(ii) which is part of the concatenated
encoder (see feature (a) of claim 1). Moreover,
according to feature (d), the bits from each
interleaver branch are mapped successively onto the
sequence of code symbols.

8. In the proceedings before the Examining Division, the
appellant cited Figure 1, claim 2, and page 7, lines 24
to 26, as a basis for feature (c). Below the Board
analyses whether any of the cited passages - or the
alternative embodiment shown in Figure 3 - can be
accepted as a basis for amended claim 1.

9. Originally filed Figure 1 (reproduced below) shows a
block diagram of the turbo-fountain encoder based on
two parallel concatenated convolutional codes (TF-A).
The two component encoders labelled "RSC" in Figure 1
are recursive systematic convolutional encoders. To the
left of the lower RSC encoder is a random interleaver,
labelled π, which is interpreted as the interleaver of
feature (a)(ii) of claim 1. Figure 1 depicts on the
right a potentially limitless number of random
interleavers (π₁, π₂, π₃,...) at the output. As it is
immediately clear from Figure 1 that only the random interleavers \((n_1, n_2, n_3, \ldots)\) at the output form interleaver branches, Figure 1 cannot be a basis for feature \((c)\) in the context of claim 1.

\[ u = (u_1, \ldots, u_k) \]

Fig. 1. Encoder structure for turbo-fountain TF-A based on parallel concatenated convolutional codes and infinite number of random interleavers at the output.

Originally filed Figure 3 (reproduced below) depicts the proposed encoder structure for the turbo-fountain (TF-B) based on an infinite parallel concatenation of recursive systematic convolutional codes. The Board identifies the concatenated encoder according to feature (a) as consisting of the two component encoders \(RSC_0\) and \(RSC_1\) and the interleaver \(n_1\), which thus represents in Figure 3 the interleaver according to feature (a)(ii) of claim 1, for the case of a single concatenated encoder consisting of two component encoders and one interleaver (see point 6 above). Interleaver branches are formed by random interleavers \(n'\) on the right of Figure 3. These interleavers \(n'\) are described on page 9, lines 17 to 18, as follows: "After random interleaving with \(n'_1\), the bits from all branches \(i\) are mapped consecutively onto the output \(c\)."
In the Board's opinion, features (c) and (d) of claim 1 can only refer to the interleavers \( \pi' \) in Figure 3, as only the bits from these branches are mapped successively onto the sequence of code symbols. Hence, Figure 3 does not provide a basis for interleaver branches directly related to the output of code symbols which are formed by an interleaver \( \pi_1 \) of the concatenated encoder.

\[
\mathbf{u} = (u_1, \ldots, u_k) \rightarrow RSC_0 \rightarrow \pi' \\
\quad \quad \quad \downarrow \pi_1 \rightarrow RSC_1 \rightarrow \pi' \\
\quad \quad \quad \downarrow \pi_2 \rightarrow RSC_2 \rightarrow \pi' \\
\quad \quad \quad \downarrow \pi_3 \rightarrow RSC_3 \rightarrow \pi' \\
\quad \quad \quad \vdots
\]

**Fig. 3.** Encoder structure for turbo-fountain TF-E based on infinite parallel concatenation of recursive systematic convolutional codes.

10. Originally filed claim 2 reads as follows:
"Apparatus according to claim 1, whereby the interleaver(s) follows the concatenated encoder(s) to spread the generated code symbols."

In the Board's view, original claim 2 cannot be a basis for feature (c), as the expression "the interleaver(s) follows the concatenated encoder(s)" clearly means that original claim 2 refers not to an interleaver according to feature (a)(ii), but only to the interleavers according to feature (b).
The passage of the original description, page 7, lines 24 to 26, that the appellant cited as a basis reads:

"[In practice, the number of required interleavers] depends on the number of required redundancy. Finally, the interleaved bits from each interleaver branch are mapped successively onto the output c."

The Board has no doubt that this passage, which describes Figure 1, refers not to the at least one interleaver defined in feature (a)(ii) of claim 1, but only to the further interleavers according to feature (b), since only these interleavers map bits to the output (c).

The appellant has not submitted further relevant arguments in reply to the Board's communication.

11. As the Board has not been able to find any other basis for feature (c) in the context of present claim 1 in the application as originally filed, it follows that claim 1 contains added subject-matter, contrary to the requirements of Article 123(2) EPC.

Clarity - Article 84 EPC

12. As the last feature of the apparatus for decoding, claim 5 recites the feature

"whereby the interleavers form at least two interleaver branches and whereby the received code symbols are distributed to different branches inversly [sic] to the procedure at the output of the apparatus of the preceding claims".

This last feature of claim 5 lacks clarity, since the apparatus of claim 1 does not specify any "procedure".
Feature (d) of claim 1 recites that "the bits from each interleaver branch are mapped successively onto the sequence of code symbols". This apparatus feature describes the function of the apparatus as a mapping, but does not define a "procedure".

12.1 The appellant has not submitted any arguments as to this objection, which was raised in the Board's communication.

12.2 As the technical features which are defined by the last feature of claim 5 cannot be understood, claim 5 lacks clarity.

13. The Board expressed further concerns in its provisional opinion, but in view of the negative findings above it is not necessary to elaborate on them.

**Procedural violation**

14. In the statement of grounds of appeal, the appellant requested at least partial reimbursement of the appeal fee because the decision was apparently based on a continuous misinterpretation of the claimed subject-matter and because the Examining Division had forced the appellant to bear higher costs due to either oral proceedings before the Examining Division or appeal proceedings, without having exhausted the informal possibilities for discussion and examination in the first-instance proceedings.

15. According to Rule 103(1)(a) EPC, the appeal fee is to be reimbursed where the board of appeal deems an appeal to be allowable, if such reimbursement is equitable by reason of a substantial procedural violation.
16. As the appeal is not allowable, one of the conditions for reimbursement of the appeal fee is not fulfilled. Hence, the request for reimbursement of the appeal fee is refused.

Conclusion

17. As the appellant's sole request cannot form the basis for the grant of a patent, the appeal is to be dismissed.

Order

For these reasons it is decided that:

1. The appeal is dismissed.

2. The request for reimbursement of the appeal fee is refused.

The Registrar: The Chairman:

I. Aperribay R. Moufang

Decision electronically authenticated