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Datasheet for the decision of 17 December 2018

Case Number: T 1116/13 - 3.5.07
Application Number: 01000393.7
Publication Number: 1191699
IPC: H03M13/29, H03M13/25, H03M13/47
Language of the proceedings: EN

Title of invention:
Parallel concatenated trellis-coded modulation with asymmetric signal mapping

Applicant:
Texas Instruments Incorporated

Headword:
Parallel concatenated trellis-coded modulation/Texas Instruments

Relevant legal provisions:
EPC Art. 84

Keyword:
Claims - clarity (no) - support in the description (no)
Case Number: T 1116/13 - 3.5.07

DECISION of Technical Board of Appeal 3.5.07
of 17 December 2018

Appellant: Texas Instruments Incorporated
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Decision under appeal: Decision of the Examining Division of the
European Patent Office posted on 4 January 2013
refusing European patent application
No. 01000393.7 pursuant to Article 97(2) EPC

Composition of the Board:
Chairman: R. Moufang
Members: M. Jaedicke
R. de Man
Summary of Facts and Submissions

I. The appeal lies from the decision of the Examining Division to refuse European patent application No. 01000393.7 for lack of inventive step in the subject-matter of claims 1 to 23 of the main request and of claims 1 to 22 of the first auxiliary request, in view of a combination of the following prior-art documents:


In an obiter dictum the Examining Division provided further comments, stating that claims 2, 7, 10 and 17 did not meet the requirements of Article 84 EPC.

II. In its statement of grounds of appeal, the appellant requested that the decision be set aside and that a patent be granted on the basis of the main request or the auxiliary request considered in the contested decision.

III. In a communication under Article 15(1) RPBA accompanying the summons to oral proceedings, the Board expressed, inter alia, its provisional opinion that the subject-matter of claim 1 of both requests lacked clarity and support.

IV. By letter dated 7 December 2018, the appellant withdrew its request for oral proceedings and requested instead a decision based on the file as it stands. It made no
substantive comments on the Board's communication.

V. 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.

VI. The appellant's final requests were that the contested decision be set aside and that a patent be granted on the basis of the main request or the auxiliary request.

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

"A communication apparatus, comprising:
an input for receiving uncoded bits from a communication application;
a first coder coupled to said input for producing coded bits from said uncoded bits;
an interleaver coupled to said input for producing from said uncoded bits an interleaved version of said uncoded bits; and
a second coder coupled to said interleaver for producing an interleaved version of said coded bits from the interleaved version of said uncoded bits;
a first mapper arranged for applying a first coded bits-to-signal mapping to said coded bits to produce a first output signal wherein said mapping is one of Gray mapping, 0231 mapping and 0213 mapping;
a second mapper arranged for applying a second coded bits-to-signal mapping to the interleaved version of said coded bits to produce a second output signal, wherein said second coded bits-to-signal mapping differs from said first coded bits-to-signal mapping;
and a combiner coupled to said first and second mappers for combining said first and second output signals to produce a combined output signal for interfacing to the
communication channel."

VIII. Claim 1 of the auxiliary request is identical to claim 1 of the main request.

Reasons for the Decision

Admissibility

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

Oral proceedings in absence of the appellant

2. The duly summoned appellant having been absent from the oral proceedings, it is treated - in accordance with its request for a decision on the state of the file - as relying only on its written case (Article 15(3) RPBA).

The invention

3. The application relates to coding and modulation in digital communications.

3.1 According to the application, the well-known Trellis-Coded Modulation (TCM) offers a substantial coding gain without requiring bandwidth expansion. This gain is achieved by an appropriate joint design of coding and modulation. Turbo codes, also known as parallel concatenated convolutional codes (PCCC), have been known to attain very low error rates within the signal-to-noise ratio range close to the Shannon limit. Attempts have therefore been made to combine TCM and turbo codes to obtain a class of powerful bandwidth-
efficient coded modulation schemes (description as published, paragraph [0003]).

Figure 2 of the application illustrates a conventional example of a parallel concatenated trellis-coded modulation (PCTCM) structure. In the example of Figure 2, the recursive systematic component code (RSC) and mapping for the upper and lower branches are identical. This type of structure is referred to as symmetric mapping PCTCM. In conventional structures such as shown in Figure 2, the PCTCM is typically designed using the conventional approach of searching for a component code that has good properties for a given mapping. Typical examples of conventional mappings that are used in arrangements like Figure 2 include natural (set partitioning) mapping and Gray mapping (paragraph [0008]).

3.2 The invention aims to provide an improved PCTCM system by mapping the coded bits of the different component coders of the turbo coder using different coded bits-to-signal mappings, i.e. it uses an asymmetric signal mapping in combination with a turbo coder (see Figures 9, 9A, 9B and 12).

Main request

4. Claim 1 of the main request relates to a "communication apparatus", which comprises the following features, as itemised by the Board:
(a) an input for receiving uncoded bits from a communication application;
(b) a first coder coupled to said input for producing coded bits from said uncoded bits;
(c) an interleaver coupled to said input for producing from said uncoded bits an interleaved version of said uncoded bits;
(d) a second coder coupled to said interleaver for producing an interleaved version of said coded bits from the interleaved version of said uncoded bits;
(e) a first mapper arranged for applying a first coded bits-to-signal mapping to said coded bits to produce a first output signal wherein said mapping is one of Gray mapping, 0231 mapping and 0213 mapping;
(f) a second mapper arranged for applying a second coded bits-to-signal mapping to the interleaved version of said coded bits to produce a second output signal, wherein said second coded bits-to-signal mapping differs from said first coded bits-to-signal mapping;
(g) a combiner coupled to said first and second mappers for combining said first and second output signals to produce a combined output signal for interfacing to the communication channel.

5. **Clarity and support - Article 84 EPC**

5.1 According to feature (a) of claim 1, the communication apparatus receives uncoded bits from a communication application as input. The received uncoded bits are processed in two different ways: the interleaver according to feature (c) interleaves the uncoded bits to produce an interleaved version of the uncoded bits and the first coder according to feature (b) codes the uncoded bits into coded bits. This is also diagrammatically illustrated by Figure 9 of the published application, which is reproduced below and shows exemplary embodiments of a PCTCM system according to the invention. Figure 9 shows that the uncoded bits
serve as input for the interleaver 27 and the recursive systematic component code coder 25 (labelled RSCC) which provides the input for the component labelled "Mapping 1".

**FIG. 9**

Feature (d) of claim 1 refers to a second coder coupled to the interleaver defined in feature (c), for producing "an interleaved version of said coded bits from the interleaved version of said uncoded bits" (emphasis added by the Board). The expression "said coded bits" in feature (d) apparently refers to the coded bits produced by the output of the first coder in feature (b), which contains the first reference in claim 1 to "coded bits". However, it is unclear how the second coder could produce an interleaved version of the coded bits obtained as output from the first coder, as the claim does not specify that the output of the first coder is used as input for the second coder.

Moreover, feature (d) is not supported by the embodiments disclosed in the application (see Figure 9 and the corresponding description, in particular
paragraph [0030]). According to Figure 9, the second coder (the RSCC coder 25 producing the input for the component labelled "Mapping 2") produces a coded version of the interleaved uncoded bits which are obtained as the output of the interleaver 27. A further interleaving function of the second coder, applied to the coded bits, is not supported by the embodiments disclosed. Hence, an interleaving of coded bits as defined by feature (d) is not supported by the application.

5.2 The above objections under Article 84 EPC were raised for the first time by the Board in its communication. As the appellant did not provide a substantive reply to the objections, there are no relevant arguments on file.

5.3 Hence, the wording of claim 1 is unclear and not supported by the description (Article 84 EPC).

Auxiliary request

6. As claim 1 of the auxiliary request is identical to claim 1 of the main request, the above objections under Article 84 EPC to claim 1 of the main request likewise apply to claim 1 of the auxiliary request.

Conclusion

7. As none of the appellant's requests can form the basis for the grant of a patent, the appeal is to be dismissed.
Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

I. Aperribay R. Moufang

Decision electronically authenticated