The examination is being carried out on the **following application documents**

Description, Pages

1-49 filed with entry into the regional phase before the EPO

Claims, Numbers

1-15 filed with entry into the regional phase before the EPO

Drawings, Sheets

1/6-6/6 filed with entry into the regional phase before the EPO

1 Reference is made to the following document; the numbering will be adhered to in the rest of the procedure.

D1 Junya Honda et al.: "Polar Coding Without Alphabet Extension for Asymmetric Models", IEEE Transactions on Information Theory, vol. 59, no. 12, December 2013, pages 7829-7838, XP055463520, ISSN: 0018-9448, DOI: 10.1109/TIT.2013.2282305

D2 Zheng Mengfan et al: "Joint Source-Channel Polar Coding for Biased Bernoulli Sources at Short Blocklengths", 11^{TH} International Symposium on Topcs in Coding, ISTC, IEEE, 30 August 2021, pages 1-5, XP034018256, DOI: 10.1109/ISTC49272.2021.9594160 [retrieved on 2021-10-28]

1.1 Document D1 discloses a method of polar coding (see title) for performing channel coding for an asymmetric channel requiring a nonuniform channel symbol distribution and for lossy source coding of nonuniform sources (see abstract and section "I Introduction"). Channel coding is disclosed in section III.A (i.e. "III. Polar Codes for Asymmetric Channels"; "A. Code Construction"). Assuming a polar code of length n having an information set I and a frozen set I^c (defined as complementary subsets of {1, 2, ...,n}), a frozen bit u_i has a deterministic value depending on the previous information and frozen bit values $u_1 \ldots u_{i-1}$ (noted u_1^{i-1}). Therefore, the frozen bits are not set to a default value such as zero.
The frozen value u_i given u_1^{i-1} is selected non-uniformly, i.e. with different probabilities of being 0 or 1, by using maps generated based on pseudorandom number sequences shared by the encoder and decoder, wherein a map is a

functions associating to binary i-tuples to a binary value, where i takes any value in the frozen set.
The information and frozen bits are then polar encoded by multiplication by a polarization matrix.
In the source coding setup (see section IV; see notations X, Y in section II), the encoder receives a non-uniformly distributed source message y_1^n , determines from y_1^n a sequence of information bits (eq. 19) and determines frozen (eq. 20) bits by using a map between info/frozen bits 1...(i-1) to {0,1}, as in the channel coding case. The encoder then sends the information bits, hence achieving a compression ratio with is the size of the information set divided by n.

1.2 Document D2 discloses a joint source-channel polar coding method for Bernouilli sources (see title). Encoding is by concatenating a source polar encoder and a channel polar encoder. At the decoder side, joint decoding is provided (see fig 3). The performance for short blocklengths (i.e. short polar code length) is improved by applying CRC-aided successive cancellation decoding to the source polar coding.

2 The application does not meet the requirements of Article 84 EPC because the claims are not clear and supported by the description.

2.1 In claim 1, the formulation "A coding method, applied to a first communications device" lacks clarity as to whether the first communications device actually performs the method.

2.2 In claim 1, the formulation "a probability distribution value P_1 of the first information bit sequence" is not clear since the specific definition of this term used in the application (see [87]-[89]) is not defined in claim 1. It results that claim 1 is not clear by itself.
Furthermore, claim 1 lacks of support in the description over the whole area claimed. According to par. [89] of the description, in the present application, a probability distribution value has the following definition: "A probability distribution value of an information bit sequence is a proportion of 0 or 1 in the information bit sequence". However, the formulation of claim 1 is vague and encompasses interpretations which are not supported by the description, such as a-priori knowledge that an information bit has a probability of being zero or one, or such as a symbol (e.g. zero or one) of a set of symbols having a probability distribution, etc...
The definition of paragraph [89] should therefore be included in claim 1.

2.3 In claim 1, the formulation "determining a frozen bit sequence" is not clear and supported by the description over its whole breadth.
A plain reading of this feature would be determining the frozen set, that is, a sequence of frozen indexes at the input of the polar encoder.
However, according to the summary of the invention, claim 1 (copied in par. [6] of the description) has the effect (see par. [7]) that "values of the first frozen bit sequence are determined based on the probability distribution value of the first information bit sequence, instead of by setting the values of the first frozen bit sequence to all 0s by default" (emphasis added). A similar disclosure is provided in par. [106]. Since claim 1 neither specifies values of the frozen bit sequence nor specifies departing from the conventional method of setting frozen its to zero, it encompasses readings (such as indicated above) which are not supported by the description. Furthermore, claim 1 does not contains the features which are essential to achieve the effect of the invention.

2.4 It is noted that the defects identified above under 2.2 and 2.3 could be overcome by amending the frozen bit sequence determining step as follows:
determining the values of a first frozen bit sequence based on a probability distribution value P_1 of the first information bit sequence without setting the values to zero by default, wherein the probability distribution value P_1 is a proportion of 0 or 1 in the first information bit sequence

2.5 Claims 3 and 13 are unclear because the claimed features appear tautological: in an equiprobable distribution, P1 is by definition equal to 0,5, so that the relationship $|P_1-0{,}5| \leq \varepsilon$ is necessarily held for any value of ε.

2.6 Claim 4 appears to be useful in the case where a pre-transformation is employed, see par. [12]. However, this case is only one of two alternative cases in claim 1. It is obscure what the technical effect of the features of claim 4 might be when applied in combination with the alternative of claim 1 were no pre-transformation is performed.

2.7 In claim 5, the formulation "the check bit sequence is located in the bits comprised in the second information bit sequence" is not clear. A plain reading the second information bit sequence contains check bits. However, in view of the par. [13] which visibly refers to the well-known technique of interspersing check bits within information bits for allowing early termination of decoding, it appears what "in" means something like "interspersed within", which is not clear from claim 5. It is noted that the term "interspersed" is not used in the application and cannot be used to clarify claim 5.

2.8 Claim 6 is not clear when dependent on the equiprobable distribution alternative of claims 1 and 2: in this case, there is only one possible probability distribution value P_1=0,5 and it would not be technically meaningful to select a different value P_0 based on P_1. It is noted that there is no disclosure in the application of alternating between the equiprobable and the non-equiprobable case.

2.9 Claim 9 is not clear for reasons similar to those of claim 6: in the configuration where P_1=0,5, it has no technical function to signalize a probability distribution reference value to a receiver.

2.10 Claim 11 is not clear for the following reasons.

2.10.1 Claim 11 is not clear for reasons corresponding to points 2.1 to 2.3 above. In relation with 2.3, claim 11 is additionally unclear because it does not link the probability distribution value to the first information sequence, so that it is unclear what the probability distribution value represents.
It is not evident how to clarify this point. Maybe the only possibility is to link claims 1 and 11 by clarifying that the second communications device (of claim 11) obtains the to-be-decoded sequence sent by the first communication device, based on par. [154]-[157], which would also imply to include the sending step in claim 1, and, in order to avoid an intermediate generalisation, to add the disclosed modulation and a demodulation steps.

2.10.2 Claim 11 does not mention polar codes/coding/decoding. Although frozen bits are mentioned and suggest that a polar code is employed, this should be made explicit in claim 11 (this would be achieved by following the suggestion made in 2.10.1).

2.11 Claim 12 is not clear for reasons corresponding to 2.8 above.

3 The present application does not meet the requirements of Article 52(1) EPC because the subject-matter of claims 1-3, 5, 10 does not involve an inventive step within the meaning of Article 56 EPC.

3.1 Concerning claims 1 and 2, first alternative.
The "first" alternative refers to the alternative of claim 2 where P_1 is an equiprobable distribution and where the first and second information bit sequences are identical.

3.1.1 Document D1 discloses a method having the following features of claim 1.

`A coding method, applied to a first communications device,`

D1, section III.A, see last paragraph of l.h. col.: "Third, the encoder sends the codeword...". The encoder is a first communication device.

wherein the method comprises:
obtaining a first information bit sequence;
D1, section III.A, see last paragraph of l.h. col.: "the encoder determines the information bits by $u_{\mathcal{I}} = m_1^{|\mathcal{I}|}$ "
determining a first frozen bit sequence based on a probability distribution value P_1 of the first information bit sequence;
D1, section III.A, see last paragraph of l.h. col.:
"Next, for the frozen bits $\mathcal{I}^c$, the encoder determines the value u_i, $i \in \mathcal{I}^c$, in the ascending order by $u_i = \lambda_i(u_1^{i-1})$"; and
"Let $M_1^{|\mathcal{I}|}$ denote a message uniformly distributed on $\{0,1\}^{|\mathcal{I}|}$". The uniform distribution corresponds to P_1=0,5.

The formula $u_i = \lambda_i(u_1^{i-1})$ expresses that the frozen bit at index i depends over the map λ_i from all information and frozen bits at indexes 1...(i-1). Since the information bits have the probability distribution value P_1=0,5, it results that the values of the frozen bits are based on P_1. This is the case because a different probability distribution value would result into different messages, which in turn results in different frozen bit values.
It is noted that the clarified formulation suggested above in section 2.4 would not be distinguished from D1.
~~determining a check bit sequence based on a second information bit sequence,~~ wherein the second information bit sequence is the first information bit sequence~~ or a sequence obtained after a pre-transformation operation is performed on the first information bit sequence;~~
obtaining a first bit sequence based on the second information bit sequence, ~~the check bit sequence,~~ and the first frozen bit sequence, wherein the first bit sequence comprises bits in the second information bit sequence, ~~bits in the check bit sequence,~~ and bits in the first frozen bit sequence;
D1, section III.A, see last paragraph of l.h. col.: "Third, the encoder sends the codeword $x_1^n = u_1^n G_n$ ", where u_1^n constitutes a first bit sequence.
Note that u_1^n contains values u_i with i being in the frozen set, and information bits $u_{\mathcal{I}} = m_1^{|\mathcal{I}|}$ which constitute the "first information bit sequence, which in turn can be identical to the "second information bit sequence" according to the above-feature of claim 1.

performing polar coding on the first bit sequence to obtain a second bit sequence; and
outputting the second bit sequence.

See again: "encoder sends the codeword $x_1^n = u_1^n G_n$ ".

3.1.2 Consequently, the method of claim 1 differs from that of D1 by using a check bit sequence based on the second information bit sequence, which may be according to claim 1 equal to the first information bit sequence, i.e. the information bits of the message to be encoded.
The objective technical problem is to increase coding performance.

3.1.3 It is notoriously known that adding parity bits, for example CRC bits, increases the performance of a polar code, especially for small block lengths in which the channels are not completely polarized.
It is also noted that document D1 discloses using successive cancellation decoding (cf. page 7833, l.h. column, after equation (25)), which can notoriously be improved by using a successive cancellation list, SCL, decoding in a so-called CRC-Aided, CA-Polar, setup where CRC bits allow to aid selecting the correct path and/or to verify whether decoding is correct.
It is also noted that document D2 shows that CRC-aided polar source coding is known in the art, in order to improve the short-block performance.
Consequently, the skilled person would arrive at the subject-matter of claims 1 and 2 without the exercise of inventive activity (note: the features of claim 2 limiting claim 1 to the first alternative defined above in the introductory paragraph of section 3.1 were assumed in the above feature analysis).

3.2 Concerning claims 1 and 2, second alternative.
The "second" alternative refers to the alternative of claim 2 where P_1 is a non equiprobable distribution and where the second information bit sequence is obtained by performing a pre-transformation on the first information bit sequence.
Reference is made to D1, section "IV. Application to Lossy Source Coding".
The complete feature analysis is not repeated below. It is noted that the pre-transformation of the first information bit sequence into the second information bit sequence (which is not present in the first alternative of claim 1 and has therefore not been mapped to D1 in the above reasoning) reads onto the operation of equation (19). It therefore appears that the subject-matter of claim 1 differs from D1, section IV, only by adding a check bit sequence, which lacks an inventive step for the same reasons as those indicated above.

3.3 Concerning claim 3
In the equiprobable case disclosed in D1, the probability distribution value is P1= 0,5 (by definition), so that $|P_1-0,5|=0$, which is smaller than any preset value.

3.4 Concerning claims 5 and 10
As indicated above having regard to claim 1, it is well-known in the art to perform CA-polar encoding/decoding with check bits interspersed within the information bits in order to assist the decoder in pruning paths in a SCL decoding method.

4 **Positive statements**

A claim based on a combination of present claims 1, 2, and 6, clarified as indicated above in sections 2.1 and 2.4 above, and furthermore clarified by deleting the equiprobable alternative from claims 1-2, would appear to be novel, inventive and clear. By doing so (by incorporating claim 6), it would also be related to the same invention as independent claim 11.
The subject-matter of claim 11 is new and inventive. Clarity issues might be overcome as indicated above.
The prior art does not suggest the subject-matter of a combination of claims 1 and 4. However, this claim combination gives rise to clarity issues as indicated above.

5 The following requirements should be attended to when filing new application documents.

5.1 To meet the requirements of Rule 43(1) (a) and (b) EPC, the independent claim should be properly cast in the two part form, with those features which are part of the prior art (see document D1) being placed in the preamble.

5.2 Reference signs in parentheses should be inserted in the claims to increase their intelligibility, Rule 43(7) EPC. This applies to both the preamble and characterising portion.

5.3 In order to indicate more completely the background art useful for understanding the invention, the above-mentioned documents D1 and D2 should be acknowledged in the description (Rule 42 (1) (b) and (c) EPC).

5.4 Paragraph [1] of the description should be deleted because it contains irrelevant subject-matter, Rule 48(1)(c) EPC, and an unallowable indication of incorporating a document by reference, cf. F-III 8.

5.5 The description should be adapted to the claims to be filed:
- The summary of the invention should be maintained in strict conformity with the claims, preferably by using a reference to the claims. Copy of superseded claims must be deleted because they suggest that the invention might be different than as defined in the claims.
- The description should be entirely reviewed to ensure that combination of features of the independent claims are not be presented as optional, that embodiments which are not covered by the independent claims are identified as such or deleted, and generally, that there are no statement suggesting that the invention might be different from what is specified in the claims. In particular, the passages of the description relating to dependent claims incorporated into an independent claims have to be checked with care.
- reference to the scope of the application (see par. [289]) should be deleted since the scope is defined by the claims.

5.6 In order to comply with the requirements of Rule 137(4) EPC, the applicant should clearly identify the amendments made and indicate the passages of the application as filed on which these amendments are based (see Guidelines H III, 2.1).