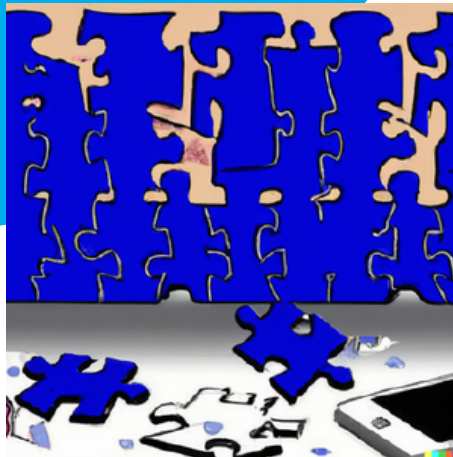


Unlocking the Future of Communications: Harnessing Ensemble Decoding for 6G

New algorithm and coding for the upcoming 6G mobile phone communication with superb energy efficiency and ultralow latency.

- Lowest latency time
- Lowest energy expenditure for coding step



Fields of application

6G mobile communication, Industry 4.0, Real time applications IoT, Medical devices, Augmented reality

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Development Status

TRL 4 - Technology checked in the laboratory

Patent Situation

PCT/EP2023/052899 pending

Reference ID

22/045TLB

Service

Technologie-Lizenz-Büro GmbH has been entrusted with the exploitation of this technology and assists companies in obtaining licenses.

Background

As we look to the future of communication systems, our focus sharpens on the horizon of 6G technology. High reliability and ultra-low latency have become increasingly important for diverse applications such as Industry 4.0, real-time medical procedures, augmented reality and a multitude of others yet to emerge.

One of the pivotal factors in modern communication system reliability is channel coding or forward error correction, a computational intensive operation directly impacting the latency of the system. To meet these opposing needs, a new promising approach, "Ensemble Decoding," has been conceptualized. Here, multiple decoders operate in parallel on slightly varied input data. After the decoding, the challenge lies in selecting the optimal solution.

In the context of mobile communication systems, these requirements directly relate to error correction methods, such as channel codes. The decoding performance and a low decoding latency play essential roles in the latency of the overall system. This concept of channel coding is already utilized in our current fifth-generation mobile communications (5G) with so-called polar codes in combination with an outer cyclic redundancy check (CRC) code.

Problem

The issue at hand is not the selection process per se, but rather the efficiency of the process when implemented in hardware, such as a chip. There is a need for an improved decoding concept for polar codes, especially for the forthcoming 6G mobile phone technology.

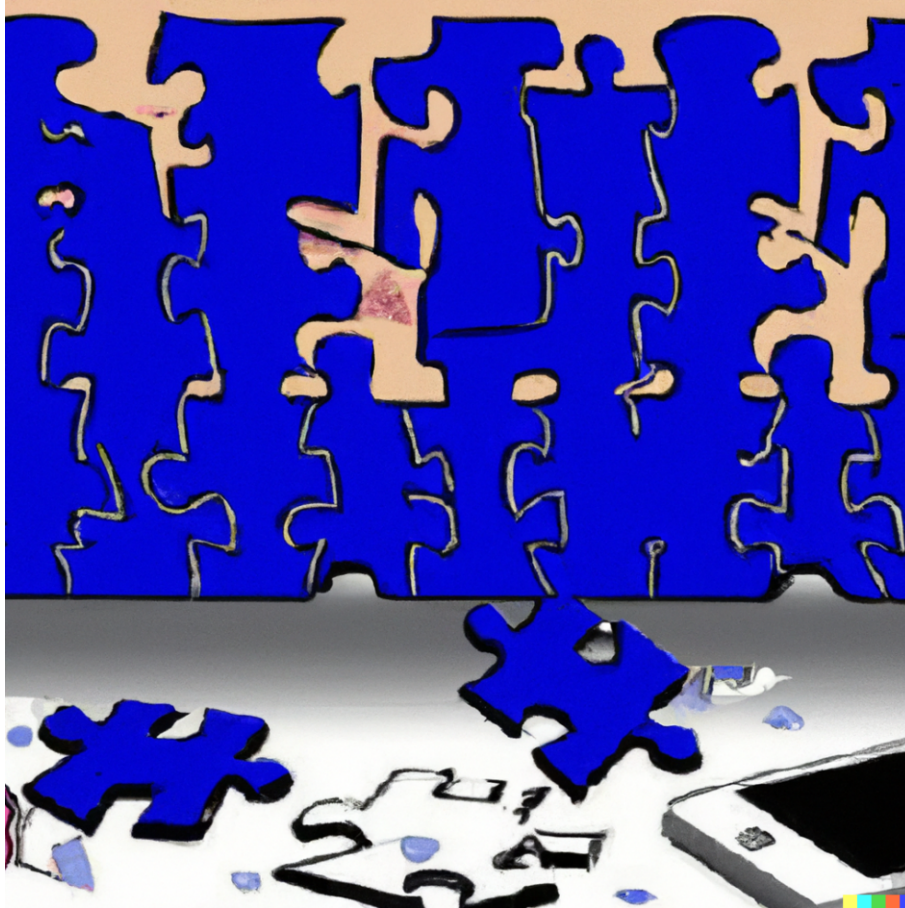
Solution

The solution lies in uniting the knowledge of the algorithm and the actual hardware architecture. Our researchers have innovated a way to perform this selection in a highly effective manner. In layman's terms, each decoder now estimates a likelihood of correctness in parallel to the decoding, effectively masking the latency. Not only is this faster, but it also conserves resources on the chip, delivering an energy-efficient solution for the ultra-low latency demanded in 6G technology.

The invention of this new way of decoding the polar codes has been compared to solving a puzzle. We take the pieces (log-likelihood ratios) and rearrange them in different ways. Each arrangement is decoded individually, forming multiple guesses about the original puzzle. A measurement, known as a path metric, is gradually calculated during the decoding process and helps decide which decoded version of the data is most likely correct. This clever method of guessing and measurement selection means we can determine the original message with the highest probability.

With this improvement, "Ensemble Decoding" is now perfectly equipped to guarantee the reliability and ultra-low latency of the forthcoming new

applications in 6G.



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Publikationen und Verweise

<https://arxiv.org/abs/2303.01235>

<https://ieeexplore.ieee.org/document/10104534>

C. Kestel, M. Geiselhart, L. Johannsen, S. ten Brink and N. Wehn, "Automorphism Ensemble Polar Code Decoders for 6G URLLC," WSA & SCC 2023; 26th International ITG Workshop on Smart Antennas and 13th Conference on Systems, Communications, and Coding, Braunschweig, Germany, 2023, pp. 1-6.