

Technology for State-of-the-Art Performance for Error-Correcting Polar Codes

Tech ID: 22877 / UC Case 2012-415-0

BACKGROUND

Progress in wireless communications over the last two decades, particularly in link layer technology, has been made possible by advancements and breakthroughs in error-control techniques, i.e. channel coding. Polar codes are truly the first explicitly proven codes within implementable complexity that can achieve Shannon capacity.

Error correcting codes are used in a multitude of applications, including wireless communications (e.g. cell phones), computer hard disks, deep-space and satellite communications. Discovered in 2009, polar codes are a major breakthrough in coding theory, the only family of codes known to have an explicit construction and efficient encoding and decoding algorithms, while also being “capacity achieving” over binary input symmetric memoryless channels.

A limitation of polar codes was that their performance at short to moderate block lengths was disappointing. There are two possible culprits: the codes themselves are inherently weak at these lengths, or the successive cancellation decoder employed to decode them is significantly degraded with respect to maximum likelihood decoding performance. These two possibilities are complementary, and so both may occur.

TECHNOLOGY DESCRIPTION

Engineers from UC San Diego have developed an algorithm (along with software implementation) that greatly improves the error-correcting performance of polar codes. This patented invention employs a decoding method for polar codes as well as a modification of the codes themselves. The resulting performance is better than the current state-of-the-art in error-correction coding, as evidenced in a study presented at the 2016 IEEE Globecom Workshops B. Zhang et al. “A 5G Trial of Polar Code” where Polar codes out performed existing Turbo code.

In the fall of 2016, the 3GPP selected Polar codes as the official coding method for the control channel functions in the 5G enhanced mobile broadband use case (one of the three main use cases being developed for 5G). Future 5G-certified mobile cellular technology will operate with a Polar code module/chipset inside.

PATENT STATUS

UC San Diego is seeking partners to commercialize this patented technology

RELATED MATERIALS

- Tal, I and A Vardy. 2011 List Decoding of Polar Codes 2011 IEEE International Symposium on Information Theory Proceedings (ISIT), July 31 2011-Aug. 5 2011
- Leroux C, AJ Raymond, G Sarkis, I Tal, A Vardy, WJ Gross. 2012 Hardware Implementation of Successive-Cancellation Decoders for Polar Codes Journal of Signal Processing Systems,69, 305-315. <http://www.springerlink.com/content/04236015n4017877/>
<http://www.springerlink.com/content/1939-8018/>

PATENT STATUS

| Country | Type | Number | Dated | Case |
|--------------------------|---------------|-----------|------------|----------|
| United States Of America | Issued Patent | 9,503,126 | 11/22/2016 | 2012-415 |

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OTHER INFORMATION

KEYWORDS

Polar codes, Successive cancellation decoding, Hardware implementation, VLSI, 5G mobile communications, List Decode, 5G

CATEGORIZED AS

- **Communications**
 - Wireless
- **Engineering**
 - Other

RELATED CASES

2012-415-0, 2012-849-0, 2011-127-0

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