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Exploring a Potential Enhancement in SC Decoding of Polar Codes: Seeking Your Insight

3 封邮件

rzc1937986979 <rzc1937986979@gmail.com> 2024年9月23日 23:32
收件人："arikan@ee.bilkent.edu.tr" <arikan@ee.bilkent.edu.tr>

Dear Professor Erdal Arıkan,

I hope this email finds you well.

My name is Zichang Ren, a PhD student from China. I was deeply impressed by your work on polar codes, both for its elegant theoretical foundations and its highly efficient performance, which has greatly inspired my research interest in the field.

I apologize for taking your time, but I have encountered a specific question regarding the Successive Cancellation (SC) decoding algorithm and have been unable to discuss it in depth with anyone around me. I hope to seek your guidance on this matter.

As I understand, the basic idea behind SC decoding is to compute the likelihood of U_i given U_1,U_2,...,U_{i−1}, and this process is carried out sequentially from i=1 to i=N. However, I noticed that the algorithm does not seem to utilize the known frozen bits after U_i, i.e., U_{i+1},U_{i+2},...,U_N. This made me wonder if incorporating this information could potentially improve the decoding performance.

After implementing this idea in code, I regrettably found that it did not result in a lower error rate. In fact, it seems that the following equality holds:

$H(U_i \mid U_{i-1})=H(U_i \mid U_{i-1}, U_A)$

where A is the set of frozen bit indices.

I've been pondering this issue for a while without any clear insight. I would greatly appreciate it if you could share your thoughts on this matter. Your response would mean a lot to me.

Thank you very much for your time and consideration.

Best regards,
Zichang Ren

Erdal Arikan <arikan@ee.bilkent.edu.tr> 2024年9月24日 16:43
收件人：rzc1937986979 <rzc1937986979@gmail.com>

Dear Zichang,

If we let U^i = U_1,...,U_i, the equality $H(U_i \mid U^{i-1})=H(U_i \mid U^{i-1}, U_A)$ is not exact but should hold asymptotically due to polarization. I guess with the insight you have, you should be able to prove the asymptotic result. You should give it a try.

Best,

Erdal

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rzc1937986979 <rzc1937986979@gmail.com> 2024年9月25日 14:09
收件人：Erdal Arikan <arikan@ee.bilkent.edu.tr>

Dear Professor Arıkan,

Thank you very much for your response and guidance. I will definitely try to prove the asymptotic result as suggested.

Best regards,
Zichang Ren