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Comment on “Relay Selection for Secure Cooperative Networks with Jamming”

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Abstract—It is the purpose of the note to point out that the Cumulative Distribution Function (CDF) (Eq. (23)) in Appendix A in the paper “Relay Selection for Secure Cooperative Networks with Jamming” by Krikidis et al. (IEEE Trans. Wireless Commun., vol. 8, no. 10, pp. 5003-5011, Oct. 2009) is not the exact expression but an approximation. We provide the exact solution of the CDF in two forms: one using Beta and hypergeometric functions and the second exploiting a recurrence relationship.

Index Terms—

I. INTRODUCTION

IN the above paper [1], Eq. (23) in Appendix A, which denotes the Cumulative Distribution Function (CDF) of $\mathcal{Z} \triangleq Z_1/Z_2$, is not exact but an approximation. The CDF is given by

$$\begin{aligned} P_{\mathcal{Z}}(y) &= \mathbb{P}\left\{\frac{Z_1}{Z_2} < y\right\} = \int_0^\infty P_{Z_1}(z_2 y) p_{Z_2}(z_2) dz_2 \\ &= (K-1)y^K \int_0^\infty \left[\frac{z_2}{(1+z_2 y)(1+z_2)}\right]^K dz_2 \quad (1) \\ &= \frac{y^K}{2^K - (1+y)^K} \left(\frac{1}{y} - 1\right), \end{aligned}$$

where K is the integer number of available decode and forward (DF) relays. This expression is needed in [1] to calculate the secrecy outage probability, when $y = 2^{2Rs}$, where $R_s > 0$ is a target secrecy rate.

In particular for $K \geq 2$ the equality given in the last line of (1) is incorrect, because

$$\int_0^\infty \left[\frac{z_2}{(1+z_2 y)(1+z_2)}\right]^K dz_2 \approx \frac{y-1}{y[2^K - (1+y)^K](K-1)}. \quad (2)$$

We therefore show correct forms of the solution to this integral. We first define

$$I_K = \int_0^\infty \left[\frac{z}{(1+zy)(1+z)}\right]^K dz, \quad (3)$$

a solution for which can be found in [2], (pp. 317, Eq. 3.197.5), as

$$I_K = B(K+1, K-1)F_1(K, K+1; 2K; 1-y), \quad (4)$$

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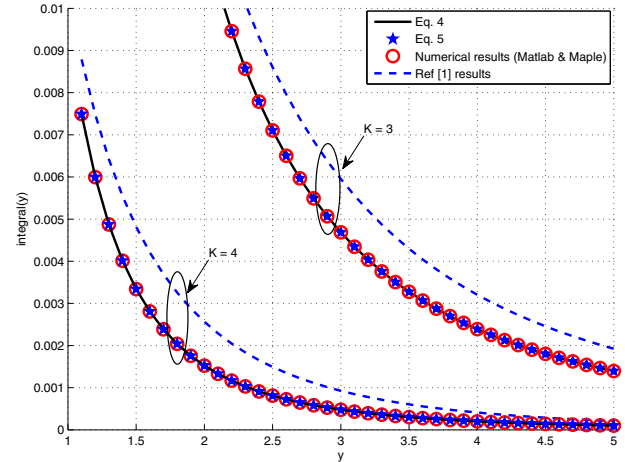


Fig. 1. The comparison between the numerical evaluation of (3) and the result given in [1] and the results in (4) and (5).

where $B(\cdot)$ denotes the Beta function and $F_1(\cdot)$ denotes the hypergeometric function; and a second solution which only requires elementary functions, as

$$I_K = \frac{4}{(2\sqrt{y})^{K+1} \sinh(\alpha)} \left[\frac{-\cosh(\alpha) I'_{K-1}}{\sinh^{2K-2}(\alpha)} + \frac{I'_{K-2}}{\sinh^{2K-4}(\alpha)} \right], \quad (5)$$

where $I'_K = [(2K-1)\cosh(\alpha)I'_{K-1} - (K-1)\sinh^2(\alpha)I'_{K-2}]/K$ with $I'_0 = \alpha = \log(y)/2$ and $I'_1 = \alpha \cosh(\alpha) - \sinh(\alpha)$.

To confirm that Eqs. (4) and (5) are correct solutions for (3), when K is an integer greater than unity, we show Fig. 1 which denotes the comparison between the numerical evaluation of (3) and the results given in [1] and our results. It can be seen that the accuracy of (2) improves as K increases. Thus, we have provided methods both to bound and correctly evaluate the CDF presented in Eq. (23) in [1]. Otherwise, the results presented in [1] are unchanged and the new selection policies for a cooperative network with secrecy constraints are correct.

REFERENCES

- [1] I. Krikidis, J. S. Thompson, and S. McLaughlin, “Relay selection for secure cooperative networks with jamming,” *IEEE Trans. Wireless Commun.*, vol. 8, no. 10, pp. 5003-5010, Oct. 2009.
- [2] I. S. Gradshteyn and I. M. Ryzhik, *Table of Integrals, Series, and Products*, 7th edition. Academic Press, 2007.