Beamforming Design of Decode-and-Forward Cooperation for Improving Wireless Physical Layer Security

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***Abstract*— Physical-layer-based security aims at ensuring the reliability of communication and preventing eavesdropping by taking advantage of the physical layer's characteristics rather than the data encryption in upper layer. Cooperation is a way to achieve this goal with many benefits for wireless communication. In particular, the cooperation scheme called decode-and-forward (DF) is discussed in this paper and our objective is to design the beamforming weight of each cooperating node which is one antenna equipped for maximum achievable secrecy rate. Considering that individual power constraint is more reasonable than total power constraint and to set noise power levels at the destination and the eavesdropper different is more practical than the same, we get the whole optimization problem which is unconvex. With the help of perfect global channel state information (CSI), the problem is solved through a way where convex optimization and one-dimensional search are combined together. And strict proofs are presented for this method. Then zero-forcing (ZF) based simplification and extension to cope with multi-antenna case are discussed. Numerical results show that the proposed design can significantly improve the security performance of wireless systems.**

***Keyword*—physical layer security, maximum achievable secrecy rate, cooperating relays, beamforming, convex analysis**

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