In-Band Full-Duplex Interference for Underwater Acoustic Communication Systems

Bilal A. Jebur, Cornelius T. Healy, Charalampos C. Tsimenidis, Jeff Neasham, Jonathon Chambers

Abstract

This work presents the first empirical measurements of the self-interference (SI) channel for the in-band full-duplex underwater acoustic (IBFD-UWA) systems. Furthermore, an adaptive self-interference cancellation (SIC) scheme, which employs the normalized least-mean-square (NLMS) algorithm to suppress the SI signal before it arrives the local analog-to-digital (ADC) converter, is introduced in this paper. Unlike the existing research work, the impact of the signal of interest, i.e. the signal received from the distant node, on the performance of the proposed SIC scheme is examined in this paper. In particular, we investigate the effect of the imperfect detection of the signal of interest on the ability of the SIC to diminish the SI signal. The obtained results demonstrate the ability of th proposed adaptive SIC to mitigate the SI signal to approximately the level of the ambient noise.

The paper will present results on modelling of SI and for an orthogonal frequency-division multiplexing (OFDM) based IBFD-UWA system whose adaptive receiver architecture is illustrated in Fig. 1. Initial results obtained are demonstrated in Fig. 2 and show that with sufficient training the proposed SIC structure can reduce SI to background noise levels.

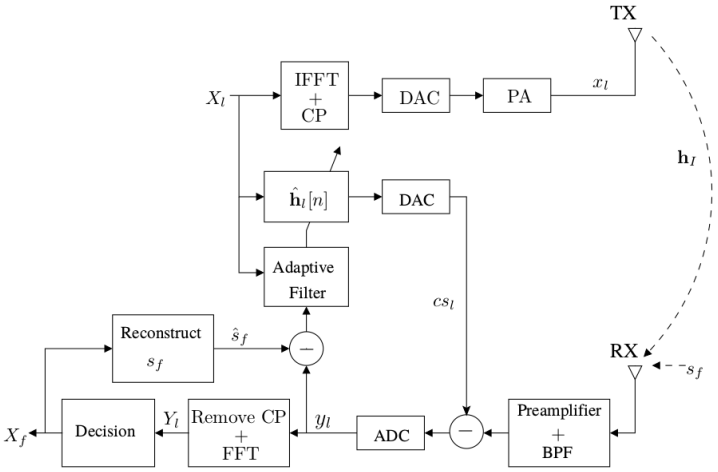

Fig 1.: Proposed receiver architecture.

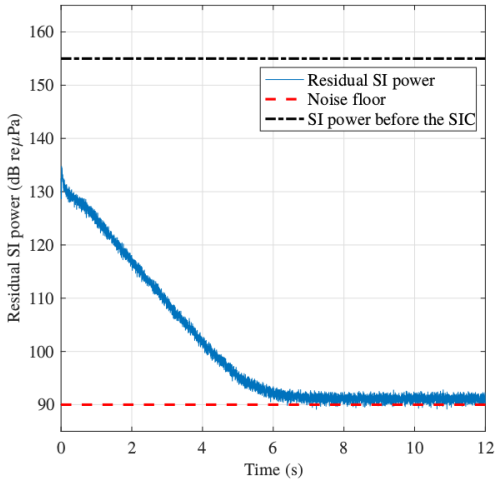

Fig. 2: Power of the residual SI signal after the adaptive SIC.

References

[1] J. Zhang, X. Ma, G. Qiao, and C. Wang, "A full-duplex based protocol for underwater acoustic communication networks," in *2013 OCEANS - San Diego*, Sept 2013, pp. 1–6.

[2] F. Qu, H. Yang, G. Yu, and L. Yang, "In-band full-duplex communications for underwater acoustic networks," *IEEE Netw.*, vol. 31, no. 5, pp. 59–65, 2017.

[3] M. Duarte, C. Dick, and A. Sabharwal, "Experiment-driven characterization of full-duplex wireless systems," *IEEE Trans. Wireless Commun.*, vol. 11, no. 12, pp. 4296–4307, December 2012.

[4] E. Everett, A. Sahai, and A. Sabharwal, "Passive self-interference suppression for full-duplex infrastructure nodes," *IEEE Trans. Wireless Commun.*, vol. 13, no. 2, pp. 680–694, February 2014.

[5] D. Korpi, J. Tamminen, M. Turunen, T. Huusari, Y. S. Choi, L. Anttila, S. Talwar, and M. Valkama, "Full-duplex mobile device: pushing the limits," *IEEE Commun. Mag.*, vol. 54, no. 9, pp. 80–87, September 2016.

[6] G. G. Xie, J. H. Gibson, and K. Bektas, "Evaluating the feasibility of establishing full-duplex underwater acoustic channels," in *Proc. of the Third Annual Mediterranean Ad Hoc Networking Workshop*, 2004.

[7] G. Qiao, S. Liu, Z. Sun, and F. Zhou, "Full-duplex, multi-user and parameter reconfigurable underwater acoustic communication modem," in *OCEANS - San Diego*, Sept 2013, pp. 1–8.

[8] L. Li, A. Song, L. J. Cimini, X.-G. Xia, and C.-C. Shen, "Interference cancellation in in-band full-duplex underwater acoustic systems," in *OCEANS 2015 - MTS/IEEE Washington*, Oct 2016, pp. 1–6.

[9] J. Tian, S. Yan, L. Xu, and J. Xi, "A time-reversal based digital cancelation scheme for in-band full-duplex underwater acoustic systems," in *OCEANS 2016 - Shanghai*, April 2016, pp. 1–4.

[10] S. S. Haykin, *Adaptive filter theory*. Pearson Education India, 2008.