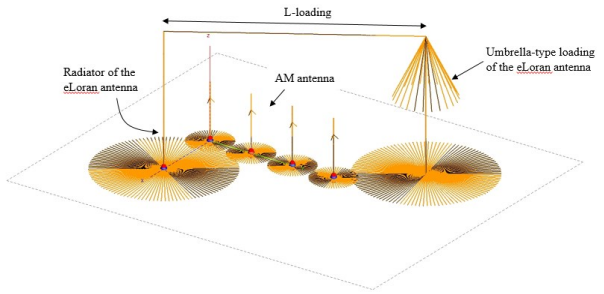


Fig. 2. Proposed eLoran antenna co-located with the AM antenna

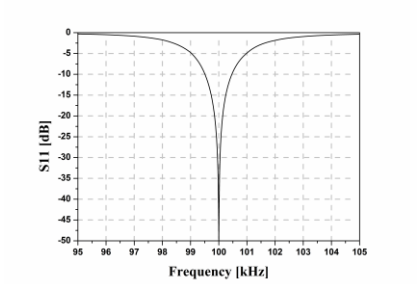
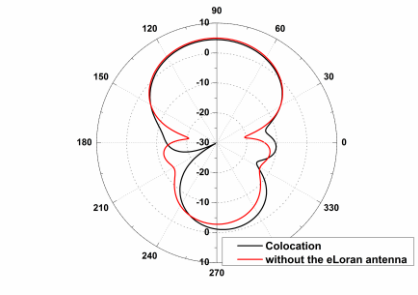
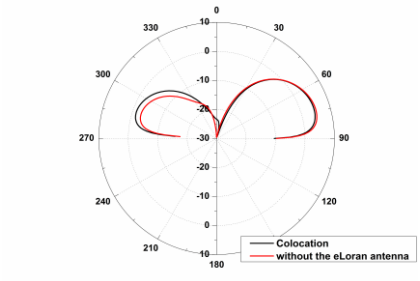


Fig. 3 Return loss of the proposed eLoran antenna, co-located with the AM antenna

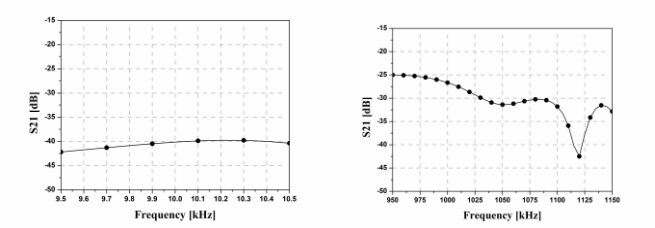


(a) H-plane



(b) V-plane

Fig. 4. Radiation pattern of the AM antenna



(a) eLoran band (b)AM band

Fig. 5. Coupling between the eLoran and the AM antenna

3. AM Antenna interference

The antenna interference between the AM antenna and eLoran antenna is verified by considering the AM radiation pattern and the coupling. Simulation results were obtained by using FEKO, a commercial software tool.

(1) Radiation pattern

The AM transmitting antenna is operated as a Yagi-Uda antenna, which consists of one radiator, one reflector, and two directors. Fig. 4 shows a comparison of the radiation pattern of the AM antenna at 1053 kHz and the operating frequency of the AM antenna. The red line signifies the radiation pattern without the eLoran antenna, and the black line represents the radiation pattern where co-location is considered. The level of antenna interference is reasonable because the two patterns are similar.

(2) Coupling

Antenna coupling between the AM and the eLoran antenna at the eLoran band and the AM band is shown in Fig. 5. The coupling is –39.53 dB at 100 kHz and –31.3 dB at 1053 kHz, respectively.

4. Conclusion

The modified L-type eLoran transmitting antenna, co-located with the AM antenna, is proposed and simulated. The simulated results show that the bandwidth of the antenna is 1.4 kHz, and the efficiency is 32.5%. There is not much difference between the co-location and the simulated AM antenna radiation patterns alone. Coupling between AM and eLoran antenna is –39.53 dB at 100 kHz and –31.3 dB at 1053 kHz, respectively. This coupling is beneficial when the proposed antenna is applied to the narrow and limited site, as in the case of the AM transmitter.

Acknowledgements

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References

[1] Johnson, G. W., ”An evaluation of eLoran as a backup to GPS,” in *IEEE Conference on Technologies for Homeland Security*, May 2007, pp. 95—100.

[2] John Pinks., "Theoretical Evaluation Suitability of USCG LSU 625’ TLM Loran Antenna at Wildwood, N.J. at 500 kHz for DRM transmission," *RTCM Paper 043-2011-SC123-085*., February 28, 2011.

[3] T. Hardy, and N. Limited, “Next generation LF transmitter technology for (e)Loran Systems,” Nav08/ILA27 Conf. & Exhib., 2008.

[4] T. L. Simpson, “The theory of top-loaded antennas: Integral equations for the currents,” *IEEE Trans. Antennas Propagat*., vol. AP-19, pp. 186–190, Mar. 1971.

[5] V. Trainotti and L. A. Dorado, “Short low and medium frequency antenna performance,” *IEEE Antennas Propag. Mag*., vol. 47, pp. 66–90,

[6] Oct. 2005.T. E. Devaney, R.F. Hall, and W.E. Gustafson, Low-frequency top loaded antenna,” *R&D Rep. 1381*, Navial Postgraduate School, California, 2 March 1987.

[7] ITU-R P.832-2 World Atlas of Ground Conductivities. 1999.