Corrections to “Lower Bounds on Q for Finite Size Antennas of Arbitrary Shape”

Kim, Oleksiy S.

Published in:
I E E E Transactions on Antennas and Propagation

Link to article, DOI:
[10.1109/TAP.2017.2679074](https://doi.org/10.1109/TAP.2017.2679074)

Publication date:
2017

Document Version
Peer reviewed version

[Link back to DTU Orbit](#)

Citation (APA):
Kim, O. S. (2017). Corrections to “Lower Bounds on Q for Finite Size Antennas of Arbitrary Shape”. *I E E E Transactions on Antennas and Propagation*, 65(5), 2773-2773. <https://doi.org/10.1109/TAP.2017.2679074>

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Corrections to “Lower Bounds on Q for Finite Size Antennas of Arbitrary Shape”

Oleksiy S. Kim

Equations (24) and (25) in Appendix B of [1] should respectively read as

$$\begin{aligned} \int_{V_\infty} -(\nabla G_1) G_2^* - \hat{\mathbf{r}} j k \frac{e^{jk(\mathbf{r}_1 - \mathbf{r}_2) \cdot \hat{\mathbf{r}}}}{16\pi^2 |\mathbf{r}|^2} dV &= -\frac{\mathbf{r}_{12}}{|\mathbf{r}_{12}|} \frac{\cos(k|\mathbf{r}_{12}|)}{8\pi} \\ &- j \frac{2\mathbf{r}_1}{8\pi k^2} \left(\frac{\sin(k|\mathbf{r}_{12}|)}{|\mathbf{r}_{12}|^3} - \frac{k \cos(k|\mathbf{r}_{12}|)}{|\mathbf{r}_{12}|^2} \right) \\ &- j \frac{|\mathbf{r}_1|^2 - |\mathbf{r}_2|^2}{8\pi k^2} \frac{\mathbf{r}_{12}}{|\mathbf{r}_{12}|^2} \left(\frac{k^2 \sin(k|\mathbf{r}_{12}|)}{|\mathbf{r}_{12}|} \right. \\ &\left. - 3 \left(\frac{\sin(k|\mathbf{r}_{12}|)}{|\mathbf{r}_{12}|^3} - \frac{k \cos(k|\mathbf{r}_{12}|)}{|\mathbf{r}_{12}|^2} \right) \right) \end{aligned} \quad (1)$$

and

$$\begin{aligned} \int_{V_\infty} j(\nabla G_1) G_2^* - \hat{\mathbf{r}} k \frac{e^{jk(\mathbf{r}_1 - \mathbf{r}_2) \cdot \hat{\mathbf{r}}}}{16\pi^2 |\mathbf{r}|^2} dV &= j \frac{\mathbf{r}_{12}}{|\mathbf{r}_{12}|} \frac{\cos(k|\mathbf{r}_{12}|)}{8\pi} \\ &- \frac{\mathbf{r}_{12}}{8\pi k^2} \left(\frac{\sin(k|\mathbf{r}_{12}|)}{|\mathbf{r}_{12}|^3} - \frac{k \cos(k|\mathbf{r}_{12}|)}{|\mathbf{r}_{12}|^2} \right) \\ &- \frac{\mathbf{r}_1 + \mathbf{r}_2}{8\pi k^2} \left(\frac{\sin(k|\mathbf{r}_{12}|)}{|\mathbf{r}_{12}|^3} - \frac{k \cos(k|\mathbf{r}_{12}|)}{|\mathbf{r}_{12}|^2} \right) \\ &- \frac{|\mathbf{r}_1|^2 - |\mathbf{r}_2|^2}{8\pi k^2} \frac{\mathbf{r}_{12}}{|\mathbf{r}_{12}|^2} \left(\frac{k^2 \sin(k|\mathbf{r}_{12}|)}{|\mathbf{r}_{12}|} \right. \\ &\left. - 3 \left(\frac{\sin(k|\mathbf{r}_{12}|)}{|\mathbf{r}_{12}|^3} - \frac{k \cos(k|\mathbf{r}_{12}|)}{|\mathbf{r}_{12}|^2} \right) \right) \end{aligned} \quad (1a)$$

$$\begin{aligned} &= j \frac{\mathbf{r}_{12}}{2} \text{Re}\{G_{12}\} - \frac{1}{2k^2} \text{Im}\{\nabla_1 G_{12}\} \\ &- \frac{\mathbf{r}_1 + \mathbf{r}_2}{2k^2} \text{Im}\{\nabla_1 G_{12} \cdot \frac{\mathbf{r}_{12}}{|\mathbf{r}_{12}|^2}\} \\ &+ \frac{|\mathbf{r}_1|^2 - |\mathbf{r}_2|^2}{2k^2 |\mathbf{r}_{12}|^2} \text{Im}\{\mathbf{r}_{12} k^2 G_{12} + 3\nabla_1 G_{12}\}. \end{aligned} \quad (1b)$$

All other results in [1] do not involve the coordinate-dependent terms (those with $\mathbf{r}_1 + \mathbf{r}_2$ and $|\mathbf{r}_1|^2 - |\mathbf{r}_2|^2$ multipliers), in which the error actually occurs, and thus, are not affected. The contribution of the coordinate-dependent terms is insignificant for $ka < 0.5$, whereas for larger ka , where the contribution gradually increases, the Q itself becomes too low to be reliably related to the bandwidth.

Further numerical results exemplifying and substantiating the general applicability of a procedure for determining the lower bound on Q outlined in Section V in [1] can be found in [2].

The expressions for the stored energies and the radiated power of arbitrary electric and magnetic currents presented in [1] (Tables I and II) can also be used for computing the Q of electrically small antennas loaded with magneto-dielectric materials, as demonstrated in [3] in the context of a surface integral equation method.

ACKNOWLEDGMENT

Prof. M. Gustafsson and Prof. B.L.G. Jonsson are acknowledged for tracking down the source of the error.

REFERENCES

- [1] O. S. Kim, “Lower bounds on Q for finite size antennas of arbitrary shape,” *IEEE Trans. Antennas Propagat.*, vol. 64, no. 1, pp. 146–154, January 2016.
- [2] —, “Lower bounds on Q of some dipole shapes,” in *Proc. IEEE Antennas Propag. Soc. Int. Symp.*, Fajardo, Puerto Rico, 26 June - 1 July 2016, pp. 415–416.
- [3] —, “Computation of the radiation Q of dielectric-loaded electrically small antennas in integral equation formulations,” in *Proc. IEEE/ACES Int. Conf. Wireless Information Technology and Systems (ICWITS) and Applied Computational Electromagnetics (ACES)*, Honolulu, Hawaii, USA, 13-17 March 2016.