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メタデータ	言語: 出版者: 琉球大学理学部 公開日: 2007-10-25 キーワード (Ja): キーワード (En): 作成者: メールアドレス: 所属:
URL	http://hdl.handle.net/20.500.12000/485

Revised Helmholtz-Thevenin's Theorem to Multi-Terminal Networks

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Abstract

The generalized Helmholtz-Thevenin's theorem in the previous paper [M. Hosoya: Bull. Faculty of Science, Univ. of the Ryukyus, 71 (2001) 39-45] is revised. The Helmholtz-Thevenin's circuit (HTC) is newly defined which is completely dual equivalent to the Mayer-Norton's one (MNC).

Conclusion

In the previous paper¹⁾, any n-terminal network was shown to be equivalent to the Helmholtz-Thevenin's circuit (HTC) and its dual equivalent Mayer-Norton's one (MNC) expanded to an n-terminal case. The explicit contents of MNC were correct, but those of HTC were not. Fig.2 in the previous paper should be revised as follows.

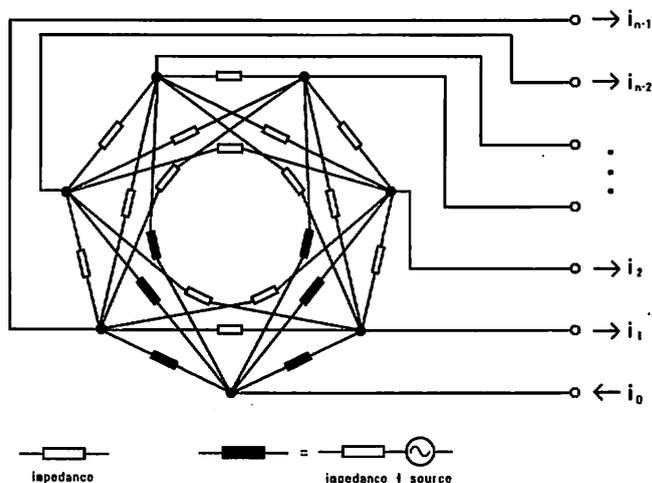


Fig.1 The Helmholtz-Thevenin's equivalent circuit of N_n .

The essence of the fault lies in that the voltage-sources are separated from the complete graph of impedances. The correct result shown in the figure contain the sources radiated from the ground node to all the other ones.

The new correct version of HTC is dual equivalent to MNC, which is naturally expected. The mistake arised from a confused procedure in the proof. In Fig. 2, a transformation is always possible from (a) to (b) by using Blakesly's theorem²⁾. The author wrongly thought that it completes the proof. But the true proof requires just the inverse. The transformation from (b) to (a) must be proved to be possible in general, which will never be performed. Therefore a circuit cannot generally have a type of equivalent circuit shown in Fig.2 of Ref. (1).

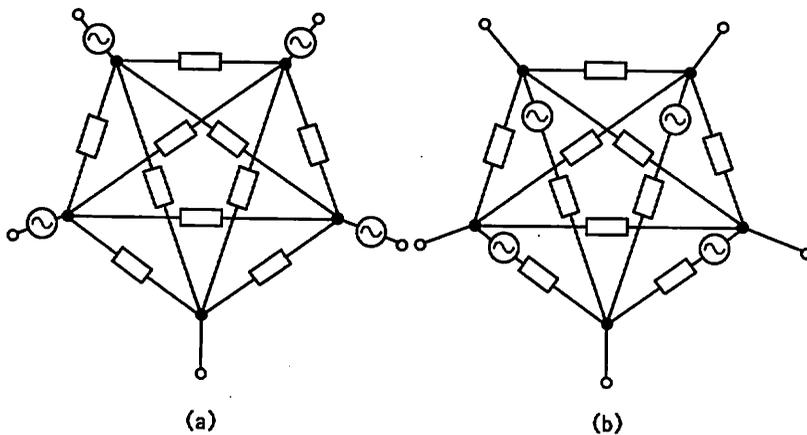


Fig.2 The old (wrong) and new Helmholtz-Thevenin's equivalent circuits of N_s .

References

- 1) M. Hosoya, "The Straightforward Expansion of Helmholtz-Thevenin Theorem to Multi-Terminal Networks", Bulletin of the Faculty of Science, University of the Ryukyus No. 71, pp. 39-45, 2001.
- 2) T. H. Blakesley, A new Electrical Theorem, Phil. Mag., vol. 37, 448-450, 1894.