

Dual Decomposition Methods for Nonlinear Resource Allocation Problems in Telecommunication Networks

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Abstract

© 2017 IEEE. We consider problems of optimal resource allocation in zonal telecommunication networks with many users. In the simplest formulation the network manager aims to distribute some homogeneous resource (say bandwidth) among users within one zone. We assume strictly convex charge and convex quadratic fee functions and present combined dual type solution methods. Next, we consider a more general problem for a multizonal wireless communication network with common capacity constraints. We obtain a convex optimization problem involving two kinds of constraints. By using the dual Lagrangian method with respect to the capacity constraint, we suggest to reduce the initial problem to a single-dimensional optimization problem, but calculation of the cost function value leads to independent solution of zonal problems, which coincide with the previous single region problem. Some results of computational experiments confirm the applicability of the new methods.

<http://dx.doi.org/10.1109/MCSI.2017.42>

Keywords

affine price functions, convex optimization, decomposition, Lagrangian duality, multizonal networks, nonlinear charge functions, Resource allocation, wireless networks

References

- [1] Courcoubetis, C., Weber, R.: Pricing Communication Networks: Economics, Technology and Modelling. John Wiley & Sons, Chichester (2003)
- [2] Stańczak, S., Wiczmanowski, M., Boche, H.: Resource Allocation in Wireless Networks. Theory and Algorithms. Springer, Berlin (2006)
- [3] Wyglinski, A.M., Nekovee, M., Hou, Y.T.: (eds.) Cognitive Radio Communications and Networks: Principles and Practice. Elsevier, Amsterdam (2010)
- [4] Chen, Y., Liestman, A.L.: A zonal algorithm for clustering ad hoc networks. Int. J. Found. of Computer Sci., vol.14, pp.305-322 (2003)
- [5] Rohloff, K., Ye, J., Loyall, J., Schantz, R.: A hierarchical control system for dynamic resource management. Proc. of the 12th IEEE Real-Time and Embed. Technol. and Appl. Symposium (RTAS 2006). Work in Progress Symposium, San Jose, (2006)
- [6] Nordin, R.: Interference-aware subcarrier allocation in a correlated MIMO downlink transmission. WSEAS Trans. on Comm., vol. 11, pp. 158-169 (2012)
- [7] Huang, X., Leng, S., Wu, F., Mao, Y.: Energy-efficient and QoS-aware resource allocation for relay-enhanced OFDMA wireless cellular networks. WSEAS Trans. on Comm., vol. 13, pp. 394-401 (2014)
- [8] Konnov, I.V., Kashina, O.A., Laitinen, E.: Optimisation problems for control of distributed resources. Int. J. Model., Ident. and Contr., vol.14, pp.65-72 (2011)

- [9] Konnov, I.V., Kashina, O.A., Laitinen, E.: Two-level decomposition method for resource allocation in telecommunication network. *Int. J. Dig. Inf. Wirel. Comm.*, vol.2, pp.150-155 (2012)
- [10] Konnov, I.V., Kashuba, A. Yu.: Decomposition method for zonal resource allocation problems in telecommunication networks. *IOP Conf. Series: Materials Science and Engineering*, vol. 158, Proc. of the 11th International Conference on "Mesh Methods for Boundary-value Problems and Applications", Art. No. 012054. 7 pp. (2016)
- [11] Konnov, I.V.: On modeling of auction type markets. *Issled. Inform.*, vol.10, pp.73-76 (2006), Available at SSRN: <http://ssrn.com/abstract=2482282>
- [12] Konnov, I.V.: An alternative economic equilibrium model with different implementation mechanisms. *Adv. Model. Optim.*, vol. 17, pp.245-265 (2015)
- [13] Konnov, I.V., Kashuba, A. Yu., Laitinen, E.: Application of the conditional gradient method to resource allocation in wireless networks. *Lobachevskii J. Mathem.*, vol.37, pp.626-635 (2016)
- [14] Konnov, I.V. Modelling of auction type markets. *Universita degli Studi di Bergamo, DMSIA Report No. 7. Bergamo, Italy.* 28 pp. (2007)
- [15] Konnov, I.V., Kashuba, A. Yu., Laitinen, E.: A simple dual method for optimal allocation of total network resources. *Recent Advances in Mathematics. Proceedings of the International Conference "PMAMCM 2015"*. Ed. by I.J. Rudas. *Zakynthos*, pp.19-21 (2015)
- [16] Polyak, B.T.: *Introduction to Optimization*. Nauka, Moscow (1983) [Engl. transl. in *Optimization Software*, New York, 1987]
- [17] Konnov, I.V.: *Nonlinear Optimization and Variational Inequalities*. Kazan Univ. Press, Kazan (2013)