Povzetek

V diplomskem delu obravnavamo **r-identifikacijske kode**. Podmnožica točk C v grafu G je r**-identifikacijska koda**, če vsaka točka v grafu G pripada enolično določeni množici krogel z radijem r in središči v točkah iz C. Predstavimo osnovne lastnosti r-identifikacijskih kod. Ogledamo si tudi njihovo uporabo v praksi in predstavimo nekatere druge vrste identifikacijskih kod, ki se izkažejo za koristne v praksi. Izpeljemo različne spodnje meje za velikost identifikacijske kode. Med drugim pokažemo, da r-identifikacijska koda v grafu z n točkami ne more biti manjše velikosti od $\lceil \log_2(n+1) \rceil$.

V nadaljevanju pokažemo, da je odločitveni problem obstoja r-identifikacijske kode dane velikosti NP-poln. V zadnjem poglavju obravnavamo **optimalne grafe**; to so grafi, v katerih obstaja r-identifikacijska koda velikosti $\lceil \log_2(n+1) \rceil$, kjer je n število točk grafa. Na koncu si ogledamo še hevrističen algoritem ID-CODE za iskanje minimalne r-identifikacijske kode v grafu. S pomočjo optimalnih grafov pokažemo, da je lahko minimalna 1-identifikacijska koda, ki jo poišče algoritem, eksponentne velikosti v primerjavi z najmanjšo 1-identifikacijsko kodo v grafu.

Literatura

[1] U. Blass, I. Honkala, S. Litsyn, Bounds on identifying codes, *Discrete Math.* **241** (2001), 119–128.

[2] A. E. Brouwer, A. M. Cohen, A. Neumaier, *Distance-regular graphs*, Springer, New York, 1989.

[3] I. Charon, O. Hudry, A. Lobstein, Extremal cardinalities for identifying and locating-dominating codes in graphs, *Discrete Math.* **307** (2007), 356–366.

[4] I. Charon, O. Hudry, A. Lobstein, Identifying and locating-dominating codes: NP-completeness results for directed graphs, *IEEE Trans. Inform. Theory* **48** (2002), 2192–2200.

[5] I. Charon, O. Hudry, A. Lobstein, Minimizing the size of an identifying or locating-dominating code in a graph is NP-hard, *Theoret. Comput. Sci.* **290** (2003), 2109–2120.

[6] T. H. Cormen, C. E. Leiserson, R. L. Rivest, *Introduction to algorithms*, MIT Press, Cambridge, 1989.

[7] M. Daniel, S. Gravier, J. Moncel, Identifying codes in some subgraphs of the square lattice, *Theoret. Comput. Sci.* **319** (2004), 411–421.

[8] A. Dobnikar, *Osnove teorije informacij*, Univerza v Ljubljani, Fakulteta za računalništvo in informatiko, 2003.

[9] A. Frieze, R. Martin, J. Moncel, M. Ruszinkó, C. Smyth, Codes identifying sets of vertices in random networks, *Discrete Math.* **307** (2007), 1094–1107.

[10] S. Gravier, R. Klasing, J. Moncel, Hardness results and approximation algorithms for identifying codes and locating-dominating codes in graphs, *Algorithmic Oper. Res.* **3** (2008), 43–50.

[11] S. Gravier, J. Moncel, A. Semri, Identifying codes of cartesian product of two cliques of the same size, *Electron. J. Combin.* **15** (2008), N4.

[12] S. Gravier, J. Moncel, A. Semri, Identifying codes of cycles, *European J. Combin.* **27** (2006), 767–776.

[13] L. Gyergyek, *Teorija o informacijah*, Fakulteta za elektrotehniko, Ljubljana, 1988.

[14] I. Honkala, T. Laihonen, On a new class of identifying codes in graphs, *Inf. Process. Lett.* **102** (2007), 92–98.

[15] I. Honkala, T. Laihonen, On identifying codes in the hexagonal mesh, *Inf. Process. Lett.* **89** (2004), 9–14.

[16] I. Honkala, T. Laihonen, S. Ranto, On strongly identifying codes, *Discrete Math.* **254** (2002), 191–205.

[17] M. Juvan, P. Potočnik, *Teorija grafov in kombinatorika*, DMFA-založništvo, Ljubljana, 2000.

[18] M. G. Karpovsky, K. Chakrabarty, L. B. Levitin, A new class of codes for identification of vertices in graphs *IEEE Trans. Inform. Theory* **44** (1998), 599–611.

[19] B. H. Korte, J. Vygen, *Combinatorial optimization: theory and algorithms*, 3. izdaja, Springer, Berlin, 2006.

[20] M. Laifenfeld, A. Trachtenberg, Identifying codes and covering problems, *IEEE Trans. Inf. Theory* **54** (2008), 3929–3950.

[21] M. Laifenfeld, A. Trachtenberg, T.Y. Berger-Wolf, Identifying codes and the set cover problem, *44th Annual Allerton Conf. on Comm., Ctrl., and Comput.* (2006).

[22] M. Laifenfeld, A. Trachtenberg, R. Cohen, D. Starobinski, Joint monitoring and routing in wireless sensor networks using robust identifying codes, *IEEE Broadnets* (2007), 197-206.

[23] A. Lobstein, *Identifying, locating-dominating and discriminating codes in graphs*, References, `http://www.infres.enst.fr/~lobstein/debutBIBidetlocdom.pdf`.

[24] J. Moncel, On graphs of n vertices having an identifying code of cardinality $\lceil \log_2(n+1) \rceil$, *Discrete Appl. Math.* **154** (2006), 2032–2039.

[25] J. Moncel, Optimal graphs for identification of vertices in networks, *Tech. Rep. 138, Lab. Leibniz* (2005), `http://www-leibniz.imag.fr/leibniz/LesCahiers/2005/Cahier138/CLLeib138.pdf`.

[26] J. Moncel, A. Frieze, R. Martin, M. Ruszink, C. Smyth, Identifying codes in random networks, *Inter. Symp.on Inform. Theory* (2005), 1464–1467.

[27] S. Ray, D. Starobinski, A. Trachtenberg, R. Ungrangsi, Robust location detection with sensor networks, *IEEE J. on Sel. Areas in Comm.* **22(6)** (2004), 1016–1025.

[28] S. Roman, *Coding and information theory*, Springer, New York, 1992.

[29] C.E. Shannon, A Mathematical theory of communication, *Bell Syst. Tech. J.* **27** (1948), 379–423 in 623–656.

[30] J. Suomela, Approximability of identifying codes and locating-dominating codes, *Inf. Process. Lett.* **103** (2007), 28-33.

[31] R. Ungrangsi, A. Trachtenberg, D. Starobinski, An implementation of indoor location detection systems based on identifying codes, Lecture Notes in Computer Science **3283** (2004), 175–189.

[32] Y.-C. Xu, R.-B. Xiao, Identifying code for directed graph, *8th ACIS Int. Conf. on Soft. Eng., Art. Intell., Net., and Par./Dist. Comp. (SNPD 2007)* **2** (2007), 97–101.

[33] R. J. Wilson, J. J. Watkins, *Uvod v teorijo grafov*, DMFA Slovenije, Ljubljana, 1997.

[34] Wikipedia, `http://www.wikipedia.org/`.