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Algorithms and obstructions for linear-width and related search parameters. (English)

Zbl 0958.05124

Discrete Appl. Math. 105, No. 1-3, 239-271 (2000).

Define the width of a linear ordering (e_1, \dots, e_r) of the edges of a graph $G = (V, E)$ to be the maximum, over all i , of the number of vertices that are incident with edges from $\{e_1, \dots, e_i\}$, and are incident with edges from $\{e_{i+1}, \dots, e_r\}$. The linear-width of a graph is the minimum width over all orderings of its edges. If we take a minor of a graph, then the linear-width cannot increase. Thus, for each k , the class of graphs of linear-width at most k is closed under taking of minors, and hence has, by the work of Robertson and Seymour, a finite characterization by its obstruction set. In this paper, the obstruction set for linear-width at most two is given: it contains exactly 57 graphs. Also, with help of a connection to the mixed search number, the paper identifies the set of acyclic forbidden minors in the obstruction set of linear-width at most k , for any $k \geq 1$; and linear time algorithms for checking linear-width, mixed search, or edge-search at most two are given; these also can construct the corresponding edge orderings or search strategies.

Reviewer: Hans L. Bodlaender (Utrecht)

MSC:

05C83 Graph minors

05C85 Graph algorithms (graph-theoretic aspects)

05C78 Graph labelling (graceful graphs, bandwidth, etc.)

Cited in 19 Documents

Keywords:

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References:

- [1] Arnborg, S.; Proskurowski, A.; Corneil, D.G., Forbidden minors characterization of partial 3-trees, Discrete math., 80, 1-19, (1990) · Zbl 0701.05016
- [2] Bienstock, D.; Dean, N., On obstructions to small face covers in planar graphs, J. combin. theory ser. B, 55, 163-189, (1992) · Zbl 0781.05014
- [3] Bienstock, D.; Seymour, P., Monotonicity in graph searching, J. algorithms, 12, 239-245, (1991) · Zbl 0760.05081
- [4] Bodlaender, H.L.; Tan, R.B.; Thilikos, D.M.; van Leeuwen, J., On interval routing schemes and treewidth, Inform. comput., 139, 1, 92-109, (1997) · Zbl 0892.68069
- [5] Bodlaender, H.L., A linear time algorithm for finding tree-decompositions of small treewidth, SIAM J. comput., 25, 1305-1317, (1996) · Zbl 0864.68074
- [6] Bodlaender, H.L.; Kloks, T., Efficient and constructive algorithms for the pathwidth and treewidth of graphs, J. algorithms, 21, 358-402, (1996) · Zbl 0861.68036
- [7] H.L. Bodlaender, D.M. Thilikos, Computing small search numbers in linear time, Report No. UU-CS-1998-05, Dept. of Computer Science, Utrecht University, 1998. · Zbl 1104.68079
- [8] Bodlaender, H.L.; Thilikos, D.M., Graphs with branchwidth at most three, J. algorithms, 32, 167-194, (1999) · Zbl 0946.68103
- [9] Breisch, R., An intuitive approach to speleotopology, A publication of the southwestern region of the national speleological society, VI, 72-78, (1967)
- [10] Chartrand, G.; Harary, F., Planar permutation graphs, Ann. inst. Henri Poincaré, 3, 433-438, (1967) · Zbl 0162.27605
- [11] Chartrand, G.; Lesniak, L., Graphs & digraphs, (1996), Chapman & Hall London · Zbl 0890.05001
- [12] B. de Fluiter, Algorithms for graphs of small treewidth, Ph.D. Thesis, Dept. Computer Science Utrecht University, 1997. · Zbl 0937.68092
- [13] Dendris, N.D.; Kirousis, L.M.; Thilikos, D.M., Fugitive-search games on graphs and related parameters, Theoret. comput. sci., 172, 1-2, 233-254, (1997) · Zbl 0903.68052
- [14] Ellis, J.A.; Sudborough, I.H.; Turner, J., The vertex separation and search number of a graph, Inform. comput., 113, 50-79,

- (1994) · [Zbl 0942.68641](#)
- [15] Fellows, M.R.; Kinnarsley, N.G.; Langston, M.A., Finite-basis theorems, and a computational integrated approach to obstruction set isolation, (), 37-45
- [16] Fellows, M.R.; Langston, M.A., Nonconstructive tools for proving polynomial-time decidability, *J. ACM*, 35, 727-739, (1988) · [Zbl 0652.68049](#)
- [17] Fellows, M.R.; Langston, M.A., On search, decision, and the efficiency of polynomial-time algorithms, *J. comput. systems sci.*, 49, 3, 769-779, (1994) · [Zbl 0938.68599](#)
- [18] Friedman, H.; Robertson, N.; Seymour, P.D., The metamathematics of the graph minor theorem, *Contemp. math.*, 65, 229-261, (1978)
- [19] Harary, F., *Graph theory*, (1969), Addison-Wesley Reading, MA · [Zbl 0797.05064](#)
- [20] Kajitani, Y.; Ishizuka, A.; Ueno, S., A characterization of the partial k -tree in terms of certain substructures, *Graphs combin.*, 2, 233-246, (1986) · [Zbl 0609.05030](#)
- [21] Kinnarsley, N.G., The vertex separation number of a graph equals its path width, *Inform. process lett.*, 42, 345-350, (1992) · [Zbl 0764.68121](#)
- [22] Kinnarsley, N.G.; Kinnarsley, W.M., An efficient polynomial-time algorithm for three-track gate matrix layout, *Comput. J.*, 37, 5, 449-462, (1994)
- [23] Kinnarsley, N.G.; Langston, M.A., Obstruction set isolation for the gate matrix layout problem, *Discrete appl. math.*, 54, 169-213, (1994) · [Zbl 0941.68590](#)
- [24] Kirousis, L.M.; Papadimitriou, C.H., Interval graphs and searching, *Discrete math.*, 55, 181-184, (1985) · [Zbl 0566.05056](#)
- [25] Kirousis, L.M.; Papadimitriou, C.H., Searching and pebbling, *Theoret. comput. sci.*, 47, 205-218, (1986) · [Zbl 0616.68064](#)
- [26] J. Lagergren, S. Arnborg, Finding minimal forbidden minors using a finite congruence, in: *Proceedings of the 18th International Colloquium on Automata, Languages and Programming*, Lecture Notes in Computer Science, Vol. 510, Springer, Berlin, 1991, pp. 532-543. · [Zbl 0764.68122](#)
- [27] Megiddo, N.; Hakimi, S.L.; Garey, M.R.; Johnson, D.S.; Papadimitriou, C.H., The complexity of searching a graph, *J. ACM*, 35, 18-44, (1988) · [Zbl 0637.68081](#)
- [28] Möhring, R.H., Graph problems related to gate matrix layout and PLA folding, (), 17-51 · [Zbl 0699.68072](#)
- [29] R. Motwani, A. Raghunathan, H. Saran, Constructive results from graph minors: Linkless embeddings, in: *Proceedings of the 29th Annual Symposium on Foundations of Computer Science*, 1988, pp. 398-407.
- [30] Parsons, T.D., Pursuit evasion in a graph, (), 426-441 · [Zbl 0379.05026](#)
- [31] Robertson, N.; Seymour, P.D., Graph width and well-quasi ordering: a survey, (), 399-406
- [32] Robertson, N.; Seymour, P.D., Disjoint paths — a survey, *SIAM J. algebraic discrete methods*, 6, 300-305, (1985) · [Zbl 0565.05045](#)
- [33] N. Robertson, P.D. Seymour, in: *Paths, Flows, and VLSI-Layout*, Bonn, 1988, Springer, Berlin, 1990, 267-292.
- [34] Robertson, N.; Seymour, P.D., Graph minors XIII. the disjoint paths problem, *J. combin. theory ser. B*, 63, 65-110, (1995) · [Zbl 0823.05038](#)
- [35] Satyanarayana, A.; Tung, L., A characterization of partial 3-trees, *Networks*, 20, 299-322, (1990) · [Zbl 0701.90092](#)
- [36] Y. Stamatidou, D.M. Thilikos, Monotonicity and inert fugitive search games, Report No. LSI-99-35-R, Departament de Llençatges i Sistemes Informàtics, Universitat Politècnica de Catalunya, 1999. · [Zbl 1072.90524](#)
- [37] Takahashi, A.; Ueno, S.; Kajitani, Y., Minimal acyclic forbidden minors for the family of graphs with bounded path-width, *Discrete math.*, 127, 1-3, 293-304, (1994) · [Zbl 0795.05123](#)
- [38] Takahashi, A.; Ueno, S.; Kajitani, Y., Minimal forbidden minors for the family of graphs with proper-path-width at most two, *IEICE trans. fund.*, E78-A, 1828-1839, (1995)
- [39] Takahashi, A.; Ueno, S.; Kajitani, Y., Mixed-searching and proper-path-width, *Theoret. comput. sci.*, 137, 253-268, (1995) · [Zbl 0873.68148](#)
- [40] R. Thomas, *Tree-Decompositions of Graphs*, Lecture Notes, School of Mathematics, Georgia Institute of Technology, 1996.

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