Reprints from Computing Reviews[1]

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GALIL, ZVI; ITALIANO, GIUSEPPE F.; AND SARNAK, NEIL
Fully dynamic planarity testing with applications.
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Since 1974, it has been known how to test graphs for planarity in linear time. This involves an $O(n)$ algorithm to see if the abstract graph's structure with n vertices is embeddable in the plane and, if so, to construct such a mapping. The incremental planarity testing problem is to perform a sequence of new edge tests and inserts on a graph known to be planar; better results for this problem were shown only ten years ago: $O(\log^2 n)$ amortized time per operation. By the fully dynamic planarity testing problem, in addition to tests and inserts, the authors allow Delete(x, y), which removes edge (x, y) from the tested graph. Planarity testing has natural applications in many areas, including VLSI layout, graphics, and CAD. In all these, there is a need to deal with fully dynamic updates, which may change the planar embedding. In this 60-page paper, we see the previous bounds pressed to the present limits: dynamic tests and deletions $O(n^{2/3})$ worst-case time per operation; and dynamic inserts $O(n^{2/3})$ amortized time per operation. The key insight, which may only be appreciated by algorithmic graph theorists, is to exploit compressed certificates (edge clusters) that certify the planarity using a much smaller subset of edges and vertices of G. Incidentally, the same techniques can be applied to biconnected and triconnected graphs. This work has 59 references, 55 lemmas, and only four theorems (Theorem 1 appears on the 52nd page!); it is a prime case for the value of *Computing Reviews*, as otherwise it is a relatively inaccessible archival version of a fairly readable symposium paper [1]. This version was in the review process for exactly six years, which seems excessive.

—F. N. Springsteel, Columbia, MO

REFERENCES

[1] GALIL, Z.; ITALIANO, G.; AND SARNAK, N. Fully dynamic planarity testing (extended abstract). In *Proceedings of the 24th Annual ACM Symposium on the Theory of Computing.* R. Kosaraju, Chr. (Victoria, B. C., Canada, May 4–6, 1992), ACM, New York, 1992, 495–506.