Selected Publications by F. Dévai

Recently he has been working on a project on theoretical models, including speedup models, for parallel and distributed computing [1, 2, 3, 4, 5, 6]. The hypothesis for the project is that no substantial theoretical impediments to general-purpose parallel computation exist. Preliminary findings of the project show that no inherently sequential fractions of workloads exist in theory and that parts of workloads possibly remaining sequential in practice do not limit speedup if the growth rate of the time requirement of the part executed in parallel is higher than that of the sequential part [2, 3].

At the beginning of his career in Budapest, Hungary, Dévai started research on algorithms and data structures [36], computational geometry [29, 31, 35, 39, 40] and computer graphics [32, 34, 38]. An $O(N \log N)$-time algorithm for determining the visibility of N non-intersecting line segments in the plane is given [39]. All the best previously published algorithms require $O(N^2)$ time for the problem. An $\Omega(N \log N)$ lower bound is also given, even if the result is not required in sorted order [39].

Using computational-geometry techniques, Dévai established the complexity of hidden-line elimination, a long-standing open problem in computer graphics [35]. The Soros Foundation awarded him a grant to present his results in the United States. His research on parallel computing started with his proof that the problem is in the complexity class NC [31].

While the $\Theta(N^2)$ hidden-line algorithm [35] only has theoretical significance, a practicable hidden-surface algorithm with $O((N + k) \log N)$ running time is also given, where N is the total number of edges in a three-dimensional polygonal model and k, $0 \leq k < N^2$, is the total number of edge intersections in the image [32].

A team, led by Dévai at the Computer and Automation Institute of the Hungarian Academy of Sciences, developed a computer-aided geometric design system, in co-operation with a Dutch company [32, 33, 37].

The most widely used hidden-surface elimination method is the z-buffer algorithm, taking $O(NR^2)$ time both in the worst case and also on average, where N is the total number of edges of the input polygons, and R^2 is the total number of picture elements of the image. An algorithm, called the z-tree method, has been proposed that takes $O(NR)$ time in the worst case [29]. Due to constant factors, the proposed algorithm gets practical advantage when the resolution R is high.

Dévai has been invited to give pre-conference tutorials at international conferences in Paris, France in 1988 [30] and 1989 [28]. In 1989 he accepted a job offer from the University of Edinburgh, UK. In 1997 he was invited to give a State of the Art report [20] to the EUROGRAPHICS'97 conference, and accepted a job offer by London South Bank University, UK.

In addition to teaching algorithms and data structures, computer graphics and distributed computing, he continued research on computational geometry [7, 9, 11, 12, 13, 14, 16, 17, 19, 24, 25] computer graphics [8, 10, 15, 21, 26] and parallel and distributed computing [18, 22, 23, 27]. New analysis [16, 19] and algorithmic [11] techniques resulted in faster and shorter algorithms than the widely accepted ones, including the Nicholl-Lee-Nicholl algorithm [13], for clipping line segments in the plane. New parallel [18, 22, 27] and distributed-computing [10, 23] approaches to visibility computations have also been proposed.

References

[1] Dévai, F. A division in computer science (Letter to the Editor) *Commun. ACM*, 65(3):8, March 2022.

[2] Dévai, F. Amdahl's law and the Gordon Bell Prize. Invited talk, presented to the *Second International Workshop on High-Performance Business Computing*, Paderborn, Germany, 24 June 2021.

[3] Dévai, F. The refutation of Amdahl's law and its variants. Invited paper, *Transactions on Computational Science*, 2018, **33**, 79–96.

[4] Dévai, F. Gustafson's law contradicts theory results. (Letter to the Editor). *Commun. ACM*, 60(4):8–9, April 2017.

[5] Dévai, F. The future of graphics processors. Presented to *Manycore and Parallel Architectures, Programming Models, and Verification Challenges*, Birmingham, UK, 19 March 2012.

[6] Dévai, F. An optimal hidden-surface algorithm and its parallelization. *International Conference on Computational Science and Its Applications* ICCSA, Santander, Spain, June 20–23, 2011, pp 17–29.

[7] Dévai, F. and Neumann, L. A rectangle-intersection algorithm with limited resource requirements. *10th IEEE International Conference on Computer and Information Technology*, Bradford, UK, June 29–July 1, 2010, pp. 2335–2340.

[8] Chalk, B., Dalal, S., Dévai, F. and Rahman M. M. Experimental evaluation of graphics algorithms. *3rd IEEE International Conference on Geometric Modeling and Imaging*, London, UK, July 2008, pp 59–65.

[9] Dévai, F. and Gavrilova, M. L. Determining the visibility of a planar set of line segments in $O(n \log \log n)$ time. *International Conference on Computational Science and Its Applications* ICCSA, Kuala Lumpur, Malaysia, August 26–29, 2007, pp 51–62.

[10] Dalal, S., Dévai, F. and Rahman M. M. High-performance rendering on clusters of workstations. *IEEE International Conference on Geometric Modeling and Imaging*, London, UK, July 5–7, 2006, pp 22–27.

[11] Dévai, F. A speculative approach to clipping line segments. *International Conference on Computational Science and Its Applications* ICCSA, Glasgow, UK, May 8–11, 2006, pp 131–140.

[12] Dalal, S., Dévai, F. and Rahman M. M. A Java-based system for large-scale rendering. In: Arge, L. et al. (Eds) *Workshop on Massive Geometric Data Sets, in connection with the 21st Annual ACM Symp. on Computational Geometry*, Pisa, Italy, June 9, 2005, pp 25–27.

[13] Dévai, F. Analysis of the Nicholl-Lee-Nicholl algorithm. *International Conference on Computational Science and Its Applications* ICCSA, Singapore, May 9–12, 2005, pp 726–736.

[14] Dalal, S., Dévai, F. and Rahman M. M. A distributed architecture for the visualisation of geometric models. *14th Annual Fall Workshop on Computational Geometry*, MIT, Cambridge, MA, USA, November 19–20, 2004, pp 26–27.

[15] Dévai, F. and Rahman M. M. The suitability of the Java language for computer-graphics and visualisation research. *IEEE International Conference on Information Visualisation, IV*, London, England, UK, July 10–12, 2002, pp 273–278.

[16] Dévai, F. An asymptotic model for clipping line segments. *International Conference on Computer Graphics and Imaging*, Las Vegas, Nevada, USA, November 19–23, 2000, pp 229–233.

[17] Variable-resolution visibility algorithms. *CISST2000, International Conference on Imaging Science, Systems, and Technology*, Las Vegas, Nevada, USA, June 26–29, 2000, pp 69–74.

[18] Dévai, F. Parallel algorithms for visibility computations. Proc. EUROGRAPHICS *UK Chapter 17th Annual Conference*, Cambridge, UK, April 13–15, 1999, pp 1–19.

[19] Dévai, F. An analysis technique and an algorithm for line clipping. *IEEE International Conference on Information Visualisation, IV'98*, London, England, UK, July 29–31, 1998, pp 157–165.

[20] Dévai, F. On the computational requirements of virtual reality systems. Invited paper, *State of the Art Reports*, EUROGRAPHICS'97, Budapest, Hungary, 4–8 September, 1997, pp 59–92.

[21] Dévai, F. The average window is small. SIGGRAPH'96 *Technical Sketches*, August 1996.

[22] Dévai, F. Test-data generation for the performance evaluation of parallel hidden-surface techniques. *Transactions on Information and Communication Technologies*, **12**, 1995, pp 3–10.

[23] Dévai, F. Scan-line methods for parallel rendering. In: Chen, M. et al. (Eds) *High-Performance Computing for Computer Graphics and Visualisation*, Swansea, Wales, UK, July 3–4, 1995, pp 88–98.

[24] Dévai, F. On the complexity of some geometric intersection problems. *Journal of Computing and Information* **1**,1 (May 1995) pp 333–352.

[25] Dévai, F. Priority-queue techniques for visibility computations. Presented to *BCTCS 11, British Colloquium on Theoretical Computer Science*, Swansea, Wales, UK, 2–5 April 1995.

[26] Dévai, F. Computational requirements for the user interfaces of computer-aided design systems. Proc. EUROGRAPHICS UK *13th Annual Conference*, Abingdon, England, UK, March 28–30, 1995, pp 117–129.

[27] Dévai, F. An optimal parallel algorithm for the visualisation of solid models. *Applications of Supercomputers in Engineering III*, Elsevier Applied Science, London, UK, 1993, pp 199–210.

[28] Dévai, F. *Computational Geometry and Image Synthesis.* Lecture Notes for Course 2, *PIXIM'89, 2nd International Conference on Computer Graphics in Paris*, France, Sept. 25–29, 1989, 88 pp.

[29] Dévai, F. Approximation algorithms for high-resolution display. Proc. *PIXIM'88, 1st International Conference on Computer Graphics in Paris*, Péroche, B. (Ed) France, Oct. 24–28, 1988, pp 121–130.

[30] Dévai, F. *Computational Geometry and Image Synthesis.* Lecture Notes for Course 4, *PIXIM'88, 1st International Conference on Computer Graphics in Paris*, France, Oct. 24–28, 1988, 83 pp.

[31] Dévai, F. An $O(\log N)$ parallel time exact hidden-line algorithm. In: Kuijk, A. A. M., Strasser, W. (Eds) *Advances in Graphics Hardware II*, Springer-Verlag, Berlin, Germany, 1988, pp 65–73.

[32] Dévai, F. An intersection-sensitive hidden-surface algorithm. In Proc. EUROGRAPHICS'87, Maréchal, G. (Ed.) Amsterdam, the Netherlands, Aug. 24–28, 1987, pp 495–502.

[33] Dévai, F., Fritsch, L., Hoffmann, P., Kocsis, F, Szilvási-Nagy, M. *IGOS — Basic Solid Modelling Facilities.* Computer and Automation Inst., Hungarian Academy of Sciences, Budapest, Hungary, 1987, 75 pp.

[34] Dévai, F. Expected-time analysis of a worst-case optimal hidden-surface algorithm. In Niku-Lari, A. (Ed) *Structural Analysis System World Conference,* Pergamon Press, Oxford, UK, 1986, pp 15–24.

[35] Dévai, F. Quadratic bounds for hidden-line elimination. Proc. *2nd Annual ACM Symposium on Computational Geometry*, Yorktown Heights, New York, USA, June 2–4, 1986, pp 269–275.

[36] Dévai, F. and van der Nat, M. Distributive merge sorting. In M. Arató, et al. (Eds.), *Topics in the Theoretical Bases and Applications of Computer Science.* Akadémiai K., Budapest, Hungary, 1986, pp. 331–338.

[37] Dévai, F. Solid modelling in IGOS. *Working Paper, GD/15*, Computer and Automation Inst., Hungarian Academy of Sciences, Oct. 1986.

[38] Dévai, F. A digital signal processor architecture for real-time image synthesis. *IEEE International Symp. on New Directions in Computing*, Trondheim, Norway, August 12–14, 1985, pp 371–376.

[39] Dévai, F. Complexity of two-dimensional visibility computations. Proc. *3rd European Conference on CAD/CAM and Computer Graphics*, Paris, France, Feb. 1984, MICAD'84 Vol. **3**, pp 827–841.

[40] Dévai, F. and Szendrényi, T. Comments on convex hull of a finite set of points in two dimensions. *Inform. Process. Lett.*, 1979, **9**, pp 141–142.