An Update of the Temporal Database Bibliography

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1 Introduction

This is the fifth in a series of bibliographies concerning temporal databases. Since the series is incremental, earlier bibliographies in the series should be consulted to find previous entries. The current bibliography includes papers that have been published since the last bibliography as well as papers that were not included in previous editions.

The most recent entry in this series was by Soo ("Bibliography on Temporal Databases," *ACM SIGMOD Record*, 20, No. 1, Mar. 1991, pp. 14–23.) Previous bibliographies were Stam & Snodgrass ("A Bibliography on Temporal Databases," *IEEE Database Engineering*, 7, No. 4, Dec. 1988, pp. 231–239), McKenzie ("Bibliography: Temporal Databases," *ACM SIGMOD Record*, 15, No. 4, Dec. 1986, pp. 40–52), and Bolour, Anderson, Dekeyser, and Wong ("The Role of Time in Information Processing: A Survey," *ACM SIGMOD Record*, 12, No. 3, 1983, pp. 27-50).

Since the last bibliography, there have been several developments in temporal databases. The International Workshop on an Infrastructure for Temporal Databases took place in Arlington, TX, June 14-16, 1993. A book describing research in temporal databases was edited by Tansel, Clifford, Gadia, Jajodia, Segev and Snodgrass (**Temporal Databases: Theory, Design, and Implementation.** Database Systems and Applications Series. Redwood City, CA: Benjamin/Cummings, 1993).

Several bibliographies have been compiled on specific areas within temporal databases. A bibliography on space and time in databases was originally published by Al-Taha, Snodgrass and Soo ("Bibliography on Spatiotemporal Databases," *ACM SIGMOD Record*, 22, No. 1, Mar. 1993), and later updated: Al-Tara, Snodgrass and Soo ("A Bibliography on Spatiotemporal Databases," to appear in the *International Journal of Geographic Information Systems*, 1993). A bibliography on incomplete and inexact information is maintained by Curtis Dyreson (email: `dyreson@cs.arizona.edu`). An annotated bibliography on schema evolution was prepared by Roddick ("Schema Evolution in Database Systems — An Annotated Bibliography," *ACM SIGMOD Record*, 21, No. 4, Dec. 1993). Temporal database papers in these subject areas were not reproduced here. These bibliographies list 144, 4, and 8 temporal database papers, respectively.

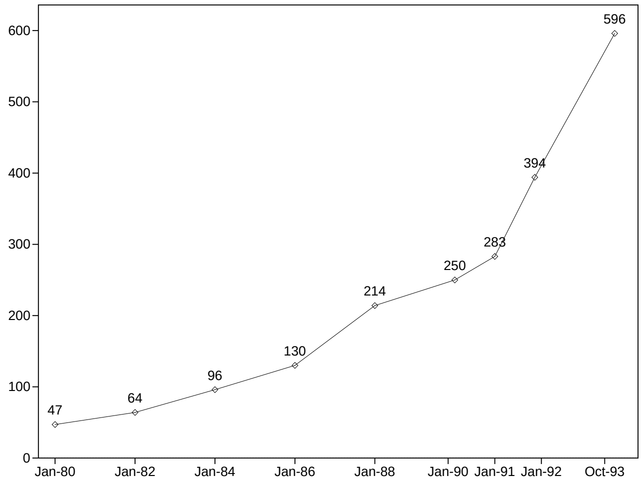

Figure 1: Temporal Database Papers

The present bibliography lists 313 new temporal database papers published or identified since the most recent bibliography, which contained bibliography entries of papers published through January, 1991 (see Figure 1). Since we do not include the temporal database papers listed in the above bibliographies, the growth of papers in the area of temporal databases is even greater than this graph shows.

This bibliography is divided into sections based on the well-accepted valid/transaction model of time (see Jensen, C. S., J. Clifford, S. K. Gadia, A. Segev, and R. T. Snodgrass "A Glossary of Temporal Database Concepts," Appendix A, pp. 621–633, in **Temporal**

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Databases: Theory, Design, and Implementation.) The four categories are enumerated below. *Valid-time* models time in the real world, such as the period of time a person worked for a company (for which we have 53 new papers). To model database time, such as the time at which a computer writes a transaction to disk, we use *transaction time* (19 new or previously unrecorded papers). Some papers discuss concepts that apply to *both valid and transaction time* (161 papers). Finally, some papers are about other aspects of time, such as how to efficiently perform calculations on time stamps or object versioning in object-oriented databases (80 new papers).

The complete bibliography is available for anonymous ftp at `ftp.cs.arizona.edu` in the `bib` directory. We apologize in advance for any errors, misclassifications, or omissions and welcome any corrections. We would like to acknowledge Patrick Kalua for providing several bibliography entries he collected, and Richard Snodgrass for comments on this paper. Any errors in the entries herein are entirely our own.

2 Valid Time

Valid time is used to model real-world time, such as the times projected for a bus to arrive at its bus-stops, or the hours actually worked at a job.

Cardenas, A., I. Ieong, R. Taira, R. Barker and C. Breant. "The Knowledge-Based Object-Oriented PICQUERY+ Language." *IEEE Transactions on Knowledge and Data Engineering*, 5, No. 4, August 1993, pp. 644–657.

Chidananda, M. R. "Query Optimization and Access Planning in Historical Database Management Systems." Master's Thesis, Department of Computer Science and Engineering, 1992.

Chieuh, T.-C. and R. Katz. "Papyrus: a Structured History Database for VLSI Design Flow Management," in *Database Systems for Advanced Applications '91*. Tokyo, Japan: Apr. 1991, pp. 293–301.

Clifford, J., A. Croker and A. Tuzhilin. "On Completeness of Historical Relational Query Languages." Technical Report STERN IS-93-8. Stern School of Business, New York University. 1993.

Clifford, J., A. Croker and A. Tuzhilin. "On the Completeness of Query Languages for Grouped and Ungrouped Historical Data Models," in Temporal Databases: Theory, Design, and Implementation. Benjamin/Cummings, 1993. Chap. 20, pp. 496–533.

Dayal, U. and G. T. J. Wuu. "A Uniform Approach to Processing Temporal Queries," in *Proceedings of the Conference on Very Large Databases*. Vancouver, Canada: Aug. 1992.

Dorda, W. G. "WAREL; A System for Retrieval of Clinical Data Considering the Course of Diseases." *Meth. Inform. Med.*, 28, Oct. 1989, pp. 133–141.

Elmasri, R., Y.-J. Kim and G. T. J. Wuu. "Efficient Implementation Techniques for the Time Index," in *Proceedings of the Seventh International Conference on Data Engineering*. 1991, pp. 102–111.

Falkenberg, E. D., J. H. L. Oei and H. A. Proper. "A Conceptual Framework for Evolving Information Systems." Technical Report 91-13. University of Nijmegen. May 1991, 1–19 pages.

Gabbay, D. and P. McBrien. "Temporal Logic and Historical Databases," in *Proceedings of the Conference on Very Large Databases*. 1991.

Ginsburg, S. "Object and Spreadsheet Histories," in Temporal Databases: Theory, Design, and Implementation. Benjamin/Cummings, 1993. Chap. 12, pp. 271–293.

Grandi, F. and M. Scalas. "A History-Oriented Temporal Query Language," in *Proceedings of the 5th IEEE Compeuro*. Bologna, Italy: May 1991.

Grandi, F., M. R. Scalas and P. Tiberio. "A primitive for recording the content of PRO-COM messages in temporal data bases.," in *5th Prometheus Workshop*. Munich, Germany: October 1991, pp. 127–141.

Grandi, F., M. Scalas and P. Tiberio. "A History-Oriented Data View and Operation Semantics for Temporal Relational Databases." Technical Report 79. CIOC-CNR. January 1991.

Grandi, F., M. R. Scalas and P. Tiberio. "History and Tuple Variables for Temporal Query Languages." Technical Report 93. C.I.O.C.-C.N.R. and D.E.I.S.. January 1993.

Hsu, S. and R. Snodgrass. "Optimal Block Size for Set-valued Attributes." *Information Processing Letters*, 45, No. 3, Mar. 1993, pp. 153–158.

Hsu, S. H. and R. T. Snodgrass. "Optimal Block Size for Repeating Attributes." TempIS Technical Report No. 28. Department of Computer Science, University of Arizona. Dec. 1991.

Hsu, S. H. "Page and Tuple Level Storage Structures for Historical Databases." TempIS Technical Report No. 34. Computer Science Department, University of Arizona. May 1992.

Johnson, R. and N. Lorentzos. "Temporal Data Management." *Information Update Database Technology*, 1 (1987), pp. 5–11.

Käfer, W. and H. Schoening. "Realizing a Temporal Complex-Object Data Model," in *Proceedings of ACM SIGMOD International Conference on Management of Data*. San Diego, CA: June 1992.

Kalua, P. and E. Robertson. "The Role of Time in Information Systems," in *Proceedings of the 2nd International Conference on Computing in Southern Africa (CISNA-91)*. April 1991, pp. 86–98.

Kline, N. "Dissertation Proposal: Efficient Evaluation of Aggregates in Temporal Databases." TempIS Technical Report 40. Computer Science Department, University of Arizona. Sep. 1992, 25 pages.

Kocberber, S. and A. Tansel. "An Index Structure for Historical Databases," in *Computer and Information Sciences VI - Proceedings of the 1991 International Symposium*. Side, Turkey: Oct.-Nov. 1991, pp. 169–178.

Landis, G. "Design Evolution and history in an Object-Oriented CAD/CAM Database," in *Proc. of IEEE*. San Francisco, USA: March 1986.

Ling, D. H. O. "Query Execution and Temporal Support in Distributed Database Systems." PhD. Dissertation. Institute of Informatics, University of Ulster, July 1988.

Ling, D. H. O. and D. A. Bell. "Modelling and Managing Time in Database Systems." *Computer Journal*, 35, No. 2 (1992), pp. 332–341.

Lipeck, U. and C. Saake. "Using Finite-Linear Temporal Logic for Specifying Database Dynamics," in Lecture Notes in Computer Science. Springer-Verlag, 1988.

Llewellyn, M. J. and M. A. Bassiouni. "Historical Database Views." *J. of Information and Software Technology*, 33, No. 2, Mar. 1991, pp. 113–120.

Lorentzos, N. "The Interval-extended Relational Model and Its Application to Valid-time Databases," in Temporal Databases: Theory, Design, and Implementation. Benjamin/Cummings, 1993. Chap. 3, pp. 67–91.

Lum, V., P. Dadam and H. Werner. "Integration of Time Versions into a Relational Database System," in *Proceedings of the Conference on Very Large Databases*. Singapore: 1984.

McBrien, P., R. Owens, D. Gabbay, M. Niezette and P. Wolper. "TEMPORA: A Temporal Database Transaction System," in *IEEE Colloquium on 'Temporal Reasoning'*. London, UK: Jan. 1990.

McBrien, P. "The Querying and Updating of a Historical Database held in an RDBMS." Internal Report 1992a. Dept. of Computing, Imperial College. 1992.

McBrien, P., A. H. Selveit and B. Wangler. "An Entity-Relationship Model Extended to describe Historical information," in *International Conference on Information Systems and Management of Data (CISMOD'92)*. Bangalore, India: July 1992, pp. 244–260.

McBrien, P., A. Seltveit and B. Wangler. "Using the TRA to Define Temporal Operators," in *Proceedings of the CISMOD 92*. Bangalore, India: 1992.

McKenzie, L. and R. T. Snodgrass. "Supporting Valid Time in an Historical Relational Algebra: Proofs and Extensions." Technical Report TR–91–15. Department of Computer Science, University of Arizona. Aug. 1991.

Ngu, A. H. H. "Specification and Verification of Temporal Relationships in Transaction Modeling." *Information Systems*, 15, No. 2 (1990).

Oomoto, E. and K. Tanaka. "Design and Implementation of a Visual Query Language for Historical Databases," in Database Systems for Next-Generation Applications. World Scientific Publishing Co., 1993. Vol. 1.

Sarda, N. "HSQL: A Historical Query Language," in Temporal Databases: Theory, Design, and Implementation. Benjamin/Cummings, 1993. Chap. 5, pp. 110–140.

Sarda, N. L. "An Algorithm for Time-rollback on Historical Relations." Technical Report. Department of Computer Science and Engineering. May 1988.

Sarda, N. L. "Time-rollback Using Logs in Historical Databases." *Information and Software Technology*, 35, No. 3 (1993), pp. 171–180.

Schäfers, L. and G. Schlageter. "Toward Full Support of Modeling and Querying Temporal Aspects in Relational Database Systems." Technical Report. University of Hagen, West Germany. 1991.

Soo, M. D., R. T. Snodgrass and C. S. Jensen. "Efficient Evaluation of the Valid-Time Natural Join," in *Proceedings of the International Conference on Data Engineering*. Feb. 1994.

Sripada, S. "Temporal Reasoning in Deductive Databases." PhD. Dissertation. Department of Computing, Imperial College of Science and Technology, January 1991.

Su, S. and H. Chen. "Temporal Rule Specification and Management in Object-Oriented Knowledge Bases." Technical Report TR-92-026. CIS Dept., University of Florida. 1992.

Su, S. Y. W. and H. M. Chen. "A Temporal Knowledge Representation Model OSAM*/T and Its Query Language OQL/T," in *Proceedings of the Conference on Very Large Databases*. 1991.

Sun, Y, T. Stockman and S. M. Deen. "Processing Temporal Data In the Relational Database." Technical Report. School of Computing, Staffordshire Polytechnic. June 1991, 15 pages.

Tansel, A. U. "Modelling temporal data." *Information and Software Technology*, 32, No. 8, Oct. 1990, pp. 514–520.

Tansel, A. U. "Temporal Relational Data Model." Technical Report. Department of Computer Engineering. 1992, 54 pages.

Tauzovich, B. "Toward Temporal Extensions to the Entity-Relationship Model," in *The 10th International Conference on the Entity Relationship Approach*. San Mateo, California: E/R Institute, Oct. 1991, pp. 163–179.

Tian, D. "An Extension of SQL for Accessing Historical Data in Heterogeneous Formats." Technical Report. Computer Science Program, University of Texas at Dallas. June 1993, 23 pages.

Tian, D. "An Extension Of The Relational Data Model Supporting Historical Data In Heterogeneous Formats." Technical Report. Computer Science Program, University of Texas at Dallas. May 1993, 27 pages.

Tin, E. and A. Tansel. "On the Expressive Power of Historical Query Languages," in *Computer and Information Sciences VI - Proceedings of the 1991 International Symposium*. Side, Turkey: Oct.-Nov. 1991, pp. 85–94.

Topaloglou, T., A. Illarramandi and L. Sbattella. "Query Optimizations for KBMSs: Temporal Syntactic and Semantic Transformations," in *Proceedings of the International Conference on Data Engineering*. Feb. 1992, pp. 310–319.

3 Transaction Time

Transaction time is database time, used when a program records the time that it performed some action, such as the time that the computer actually updated a tuple, or the time that a computer recorded the information about an employee's working hours.

Alter, G. and M. Gutmann. "Casting Spells: Database Concepts for Event History Analysis." Working Paper No. 92-1. Population Institute for Research and Training, Indiana University. December 1991.

Bækgaard, L. and L. Mark. "Specification and Monitoring of Transaction Dependencies." Technical Report UMIACS-TR-91-74. Institute for Advanced Computer Studies and Department for Computer Science, University of Maryland. Oct. 1991, 26 pages.

Bækgaard, L. and L. Mark. "Incremental Evaluation of Time-Varying Queries Using Predicate Caches." Technical Report UMIAC-TR-92-64/CS-TR-2912. University of Maryland. June 1992, 26 pages.

Bækgaard, L. and L. Mark. "Incremental Evaluation of Time-Varying Selections." Technical Report UMIACS-TR-92-65/CS-TR-2913. University of Maryland. June 1992, 17 pages.

Bassiouni, M. A. and M. J. Llewellyn. "A Relational-Calculus Query Language For Historical Databases." *Computer Languages*, 17, No. 3 (1992), pp. 185–197.

Cho, T. N. and K. C. Kim. "Design of Historical Databases using the 3-D Relational Data Model," in *The 3rd International Symposium on Database Systems for Advanced Applications*. Taejon, Korea: Apr. 1993.

Elmasri, R., M. Jaseemuddin and V. Kouramajian. "Partitioning of Time Index for Optical Disks," in *Proceedings of the International Conference on Data Engineering*. Ed. F. Golshani. IEEE. Phoenix, AZ: Feb. 1992, pp. 574–583.

Henzinger, T. "The Temporal Specification and Verification of Real-time Properties." PhD. Dissertation. Department of Computer Science, Stanford University, 1992.

Jensen, C. and L. Mark. "Differential Query Processing in Transaction-Time Databases," in Temporal Databases: Theory, Design, and Implementation. Benjamin/Cummings, 1993. Chap. 19, pp. 457–491.

Jensen, C. S., L. Mark, N. Roussopoulos and T. Sellis. "Using Differential Techniques to Efficiently Support Transaction Time." *The VLDB Journal*, 2, No. 1, Jan. 1993, pp. 75–111.

Kolovson, C. "Indexing Techniques for Historical Databases," in Temporal Databases: Theory, Design, and Implementation. Benjamin/Cummings, 1993. Chap. 17, pp. 418–432.

Leung, T. Y. and R. Muntz. "Generalized Data Stream Indexing and Temporal Query Processing," in *Second International Workshop on Research Issues in Data Engineering: Transaction and Query Processing.* Feb. 1992.

Lomet, D. and B. Salzberg. "Media Recovery with Time-Split B-trees." Technical Report NU-CCS-91-16. College of Computer Science Northeastern University. 1991, 42 pages.

Lomet, D. and B. Salzberg. "Rollback Databases." Technical Report NU-CCS-92-3. Northeastern University. 1992.

Lomet, D. and B. Salzberg. "Transaction-Time Databases," in Temporal Databases: Theory, Design, and Implementation. Benjamin/Cummings, 1993. Chap. 16, pp. 388–417.

Özsoyoğlu, G., K. Du, S. Guru swamy and W.-C. Hou. "Processing Real-Time, Non-Aggregate Queries with Time-Constraints in CASE-DB," in *Proceedings of the International Conference on Data Engineering.* Ed. F. Golshani. Los Alamitos, CA: IEEE Computer Society Press, Feb. 1992, pp. 410–417.

Ramamritham, K. "Real-Time Databases." *International Journal of Distributed and Parallel Databases* (1992).

Sarda, N. L. "Time Grid: A File Structure for Historical Databases." Technical Report. Department of Computer Science & Engineering, I.I.T.. Apr. 1992, 26 pages.

Tsotras, V. J. and B. Gopinath. "Efficient Algorithms Managing the History of Evolving Databases," in *Proceedings of the International Conference on Database Theory.* 1990.

4 Both Transaction and Valid Time

Some papers consider both transaction and valid time.

Ahn, I. "SQL+T: a Temporal Query Language," in *Proceedings of the International Workshop on an Infrastructure for Temporal Databases.* Ed. R. T. Snodgrass. Arlington, TX: June 1993.

Alexakis, P. and B. Theodoulidis. "The TEMPORA Deductive Repository Metamodelling and Validation Support," in *Proc. Workshop on Next Generation CASE Tools.* NGCT'92. Manchester, England: 1992.

Allen, J. F. "An Interval-Based Representation of Temporal Knowledge," in *Proceedings of the International Joint Conference on Artificial Intelligence.* Vancouver: 1981, pp. 221–226.

Ariav, G. "Information Systems for Managerial Planning and Control: A Conceptual Examination of their Temporal Structure." *Journal of MIS*, 8, No. (forthcoming) (1992).

Ariav, G. "Tools for Managing Temporally Oriented Data: Are they really Practicallly Relevant?," in *Proceedings of the International Workshop on an Infrastructure for Temporal Databases.* Ed. R. T. Snodgrass. Arlington, TX: June 1993.

Balthazaar, C., Gray A. and T. Lawson. "An Object-Oriented Temporal Model Embodied as Eiffel Software Components," in *Proc. Conf. Technology of Object-Oriented Languages and Systems (TOOLS).* 1991, pp. 249–257.

Baudinet, M., J. Chomicki and P. Wolper. "Temporal Deductive Databases," in Temporal Databases: Theory, Design, and Implementation. Benjamin/Cummings, 1993. Chap. 13, pp. 294–320.

Baudinet, M., J. Chomicki and P. Wolper. "Temporal Databases: Beyond Finite Extensions," in *Proceedings of the International Workshop on an Infrastructure for Temporal Databases.* Ed. R. T. Snodgrass. Arlington, TX: June 1993.

Bhargava, G. and S. K. Gadia. "A 2-dimensional Temporal Relational Database Model for Querying Errors and Updates, and for Achieving Zero Information-loss." Technical Report TR#89-24. Department of Computer Science, Iowa State University. Dec. 1989.

Blakeley, J. "Challenges for Research on Temporal Databases," in *Proceedings of the International Workshop on an Infrastructure for Temporal Databases.* Ed. R. T. Snodgrass. Arlington, TX: June 1993.

Buchmann, A. P. and H. Branding. "On Combining Temporal and Real-Time Databases," in *Proceedings of the International Workshop on an Infrastructure for Temporal Databases.* Ed. R. T. Snodgrass. Arlington, TX: June 1993.

Chakravarthy, S. and S. K. Kim. "Semantics of Time-Varying Information and Resolution of Time Concepts in Temporal Databases," in *Proceedings of the International Workshop on an Infrastructure for Temporal Databases.* Ed. R. T. Snodgrass. Arlington, TX: June 1993.

Chandra, R. and A. Segev. "Managing Temporal Financial Data in an Extensible Database," in *Proceedings of the Conference on Very Large Databases.* Dublin, Ireland: Sep. 1993.

Chen, H. H. M. "Temporal Knowledge Base Management: Model, Query Language, Algebra, and Implementation Techniques." PhD. Dissertation. Electrical Engineering Dept., University of Florida, May 1993.

Cheng, T. S. and S. K. Gadia. "An Object-Oriented Model for Temporal Dataabases," in *Proceedings of the International Workshop on an Infrastructure for Temporal Databases.* Ed. R. T. Snodgrass. Arlington, TX: June 1993.

Chomicki, J. "Temporal Databases (tutorial notes)." Technical Report TR-CS-93-12. Department of Computing and Information Sciences, Kansas State University. May 1993.

Chu, W. W., I. T. Ieong, R. K. Taira and C. M. Breant. "A Temporal Evolutionary Object-Oriented Data Model and Its Query Language for Medical Image Management," in *Proceedings of the Conference on Very Large Databases.* Vancouver, Canada: Aug. 1992.

Clifford, J. and A. Croker. "The Historical Relational Data Model (HRDM) Revisited," in Temporal Databases: Theory, Design, and Implementation. Benjamin/Cummings, 1993. Chap. 1, pp. 6–27.

Clifford, J. and T. Isakowitz. "On the Semantics of Transaction Time and Valid Time in Bitemporal Databases," in *Proceedings of the International Workshop on an Infrastructure for Temporal Databases.* Ed. R. T. Snodgrass. Arlington, TX: June 1993.

Clifford, J., A. Croker and A. Tuzhilin. "Grouped and Ungrouped Historical Data Models: Expressive Power and Completeness," in *Proceedings of the International Workshop on an Infrastructure for Temporal Databases.* Ed. R. T. Snodgrass. Arlington, TX: June 1993.

Console, L., B. Pernici and P. Terenziani. "Towards the Development of a General Temporal Manager for Temporal Databases: a Layered and Modular Approach," in *Proceedings of the International Workshop on an Infrastructure for Temporal Databases.* Ed. R. T. Snodgrass. Arlington, TX: June 1993.

Dayal, U. and G. T. J. Wuu. "Extending Existing DBMSs to Manage Temporal Data: An Object-Oriented Approach," in *Proceedings of the International Workshop on an Infrastructure for Temporal Databases.* Ed. R. T. Snodgrass. Arlington, TX: June 1993.

De Castro, C., F. Grandi and M. R. Scalas. "Interoperability of Heterogeneous Temporal Relational Databases." Technical Report 94. C.I.O.C.-C.N.R.. May 1993.

Dey, D., T. Barron and V. Storey. "A Well-Specified Temporal Relational Model," in *Proceedings of the Thirteenth Annual International Conference on Information Systems.* Dallas, Texas: December 1992, pp. 241–253.

Dittrich, K. R. and S. Gatziu. "Time Issues in Active Database Systems," in *Proceedings of the International Workshop on an Infrastructure for Temporal Databases.* Ed. R. T. Snodgrass. Arlington, TX: June 1993.

Edara, M. and S. Gadia. "Updates and Incremental Recomputation of Active Relational Expressions in Temporal Databases," in *Proceedings of the International Workshop on an Infrastructure for Temporal Databases.* Ed. R. T. Snodgrass. Arlington, TX: June 1993.

El-Assab, I. "Query Language Constructs for Temporal Databases." Master's Thesis, Dept. of Computer Science, University of Houston, Dec. 1990.

Elmasri, R. and V. Kourmajian. "A Temporal Query Language Based on Conceptual Entities and Roles," in *International Conference on the Entity Relationship Approach.* Karlsruhe, Germany: Oct. 1992.

Elmasri, R. and V. Kouramajian. "Indexing, Searching and Archiving Issues in Temporal Databases," in *Proceedings of the International Workshop on an Infrastructure for Temporal Databases.* Ed. R. T. Snodgrass. Arlington, TX: June 1993.

Elmasri, R., G. Wuu and V. Kouramajian. "A Temporal Model and Query Language for EER Databases," in Temporal Databases: Theory, Design, and Implementation. Benjamin/Cummings, 1993. Chap. 9, pp. 212–229.

Elmasri, R., V. Kouramajian and R. Guntor. "Access Structures and Search Methods for Temporal Databases." Technical Report. Computer Science Engineering, University of Texas at Arlington. 1993.

Elmasri, R., Wuu, G. and V. Kouramajian. “The Time Index and the Monotonic B+ Tree,” in Temporal Databases: Theory, Design, and Implementation. Benjamin/Cummings Pub. Co, 1993. Chap. 18, pp. 433–456.

Etzion, O., A. Gal and A. Segev. “Temporal Active Databases,” in *Proceedings of the International Workshop on an Infrastructure for Temporal Databases*. Ed. R. T. Snodgrass. Arlington, TX: June 1993.

Etzion, O., A. Gal and A. Segev. “On Rules in Temporal Databases.” Technical Report LBL-34062. Lawrence Berkeley Laboratory. 1993.

Etzion, O., A. Gal and A. Segev. “Rule and Transaction Processing in Temporal Active Databases.” Technical Report. Lawrence Berkeley Laboratory. 1993.

Fauvet, M. C. “Modelling and Managing Versions and Histories in an Object Oriented Environment.” Technical Report Aristote RAP015. Aristote Project. July 1991.

Fauvet, M. C. “Generating Object-Oriented Applications with Versions and Histories,” in *International Conference on Information Systems and Management of Data (CISMOD'92)*. Bangalore, India: July 1992, pp. 35–53.

Finger, M. “Handling Database Updates in Two-Dimensional Temporal Logic.” *Journal of Applied Non-Classical Logics*, 2, No. 2 (1992).

Gadai, S. K. and G. Bhargava. “SQL-like Seamless Query of Temporal Data,” in *Proceedings of the International Workshop on an Infrastructure for Temporal Databases*. Ed. R. T. Snodgrass. Arlington, TX: June 1993.

Gadia, S. “Ben-Zvi's Pioneering Work in Relational Temporal Databases,” in Temporal Databases: Theory, Design, and Implementation. Benjamin/Cummings, 1993. Chap. 8, pp. 202–207.

Gadia, S. and S. Nair. “Temporal Databases: A Prelude to Parametric Data,” in Temporal Databases: Theory, Design, and Implementation. Benjamin/Cummings, 1993. Chap. 2, pp. 28–66.

Gadia, S. K. and C.-S. Yeung. “Inadequacy of Interval Timestamps in Temporal Databases.” *Information Sciences*, 54 (1991), pp. 1 – 22.

Gadia, S. K. “A Seamless Generic Extension of SQL for Querying Temporal Data.” Technical Report TR-92-02. Computer Science Department, Iowa State University. May 1992, 54 pages.

Gadia, S. K. and S. Nair. “McKenzie-Snodgrass Type Evaluation of an Algebra for Temporal Databases.” Technical Report TR-92-20. Computer Science Department, Iowa State University. 1992.

Ghallab, M. and A. Alaoui. “Managing Efficiently Temporal Relations Through Indexed Spanning Trees,” in *Proceedings of IJCAI*. 1989.

Goralwalla, I. and A. U. Tansel. “A Temporal Relational Database Management System,” in *Proceedings of the Sixth International Symposium on Computer and Information Sciences*. Antalya, Turkey: Oct. 1991, pp. 75–83.

Goralwalla, I. and A. U. Tansel. “A Temporal Relational Database Management System.” Technical Report. Bilkent University. July 1992.

Goralwalla, I. and A. U. Tansel. “Performance Evaluation of Temporal Relational Databases.” Technical Report. Bilkent University. July 1992.

Goralwalla, I. and M. T. Özsu. “Temporal Extensions to a Uniform Behavioral Object Model,” in *Proceedings of the International Workshop on an Infrastructure for Temporal Databases*. Ed. R. T. Snodgrass. Arlington, TX: June 1993.

Goyal, P., Y.-Z. Qu and F. Sadri. “The Temporal Object Model,” in *Research and Practical Issues in Databases. Proceedings of the 3rd Australian Database Conference*. Melbourne, Victoria, Austrialia: Feb. 1992, pp. 36–50.

Gunadhi, H. and A. Segev. “Efficient Indexing Methods for Temporal Relations.” *IEEE Transactions on Knowledge and Data Engineering*, 5, No. 3, June 1993, pp. 496–509.

Hainaut, J. L. “A Temporal Statistical Model for Entity-Relationship Schemas,” in *Proceedings of the 11th International Conference on the Entity Relationship Approach*. University of Karlsruhe. Germany: Oct. 1992.

Hulsmann, K. “A Temporal-logic-based Query Language for Querying Database Histories,” in *DEXA 91*. Berlin, Germany: Aug. 1991, pp. 393–399.

Jang, Y. P. and R. G. Johnson. “A Heterogeneous Temporal Nested Relational Data Model.” Antalya, Turkey: ISCIS 7. Nov. 1992.

Jensen, C. and R. Snodgrass. “Three Proposals for a Third-Generation Temporal Data Model,” in *Proceedings of the International Workshop on an Infrastructure for Temporal Databases*. Ed. R. T. Snodgrass. Arlington, TX: June 1993.

Jensen, C. S. and R. T. Snodgrass. "Proposal of a Data Model for the Temporal Structured Query Language." TempIS Technical Report 37. Computer Science Department, University of Arizona. July 1992.

Jensen, C. S. and R. Snodgrass. "Temporal Specialization and Generalization." *IEEE Transactions on Knowledge and Data Engineering*, (to appear) (1993).

Jensen, C. S., M. D. Soo and R. T. Snodgrass. "Unification of Temporal Relations," in *Proceedings of the International Conference on Data Engineering*. Vienna, Austria: Apr. 1993, pp. 262–271.

Jensen, C. S., M. D. Soo and R. T. Snodgrass. "Unifying Temporal Data Models via a Conceptual Model." Technical Report 93-31. Computer Science Department, University of Arizona. Sep. 1993, 35 pages.

Jensen, C.S. and R. Snodgrass. "Temporal Specialization," in *Proceedings of the International Conference on Data Engineering*. Ed. F. Golshani. IEEE. Tempe, AZ: Feb. 1992, pp. 594–603.

Käfer, W., N. Ritter and H. Schoening. "Support for Temporal Data by Complex Objects," in *16th International Conference on VLDB*. Brisbane, Australia: Aug. 1990.

Käfer, W. "Temporal Selection, Temporal Projection, and Temporal Join Revised," in *Proceedings of the International Workshop on an Infrastructure for Temporal Databases*. Ed. R. T. Snodgrass. Arlington, TX: June 1993.

Kahn, M., S. Tu and L. Fagan. "TQuery: a Context-sensitive Temporal Query Language." *Computers and Biomedical Research*, Oct. 1991, pp. 401–419.

Kalua, P. P. "Supporting Time With Nested Relational Database Systems." PhD. Dissertation. Computer Science Department, Indiana University, Bloomington, 1993.

Kalua, P. P. and E. L. Robertson. "Benchmarks for Temporal Databases." Technical Report 379. Computer Science Department. March 1993.

Kamens, S. N. and G. Wiederhold. "An Implementation of Temporal Queries for SQL." Technical Report. Department of Computer Science, Stanford University. 1990.

Kangelaris, N. and V. Tsotras. "Access Methods for Historical Data," in *Proceedings of the International Workshop on an Infrastructure for Temporal Databases*. Ed. R. T. Snodgrass. Arlington, TX: June 1993.

Karimi, S., M. Bassiouni and A. Orooji. "Supporting Temporal Capabilities in a Multi-Computer Database System," in *Proceedings of the International Conference on Databases, Parallel Architectures and Their Applications*. PARBASE-90. Miami, FL: 1990, pp. 20–26.

Kedem, Z. M. and A. Tuzhilin. "Relational Database Behavior: Utilizing Relational Discrete Event Systems and Models," in *Proceedings of the ACM Symposium on Principles of Database Systems*. 1989.

Kim, J. and Y. Lee. "A Temporal Data Model Using Extending Set," in *Future Database'92, Proceedings of the Second Far-East Workshop on Future Database Systems*. Kyoto, Japan: Apr. 1992, pp. 77–80.

Kim, S.-K. "A Formal Approach to Two-Dimensional Temporal Databases." Master's Thesis, Department of Computer and Information Sciences, University of Florida, December 1992.

Kim, S.-K. and S. Chakravarthy. "A Retrospective Analysis of Time Concepts in Temporal Databases." Technical Report UF-CIS-TR-92-044. CIS Department, University of Florida. 1992.

Kolovson, C. and M. Stonebraker. "Segment Indexes: Dynamic Indexing Techniques for Multidimensional Interval Data," in *Proceedings of ACM SIGMOD International Conference on Management of Data*. May 1991.

Kouramajian, V. and R. Elmasri. "Mapping of 2-D Temporal Extended ER Models into Temporal FNF and NFNF Relational Models," in *The 10th International Conference on the Entity Relationship Approach*. San Mateo, California: E/R Institute, Oct. 1991, pp. 671–689.

Kowalski, R. "Database Updates in the Event Calculus." *The Journal of Logic Programming*, Dec. 1992, pp. 121–146.

Landau, G. M., J. P. Schmidt and V. J. Tsotras. "Efficient Support of Historical Queries for Multiple Lines of Evolution," in *Ninth International Conference on Data Engineering*. Association for Computing Machinery. Vienna, Austria: ACM Press, Apr. 1993, pp. 319–326.

Lawson, T., C. Balthazaar and A. Gray. "An Object-Oriented Approach to Temporal Modelling," in *Proceedings of the International Workshop on an Infrastructure for Temporal Databases*. Ed. R. T. Snodgrass. Arlington, TX: June 1993.

Lelakis, G. "Experimental Extension of SQL for the Management of Intervals." Master's Thesis, National Technical University of Athens, 1990.

Leung, T. and R. Muntz. "Stream Processing: Temporal Query Processing and Optimization," in Temporal Databases: Theory, Design, and Implementation. Benjamin/Cummings, 1993. Chap. 14, pp. 329–355.

Leung, T. Y. and R. Muntz. "Temporal Query Processing and Optimization in Multiprocessor Database Machines." Technical Report CSD-910077. Computer Science Department, UCLA. Nov. 1991.

Leung, T. Y. and R. Muntz. "Stream Processing: Temporal Query Processing and Optimization." Technical Report CSD-910079. University of California, Los Angeles. Dec. 1991, 34 pages.

Leung, T. Y. C. "Query Processing and Optimization in Temporal Database Systems." PhD. Dissertation. Department of Computer Science, University of California, 1992.

Leung, T. Y. C. and R. R. Muntz. "Temporal Query Processing and Optimization in Multiprocessor Database Machines," in *Proceedings of the Conference on Very Large Databases*. Vancouver, Canada: Aug. 1992.

Li, B. and T. Ting. "An Event-state Approach to Handling Temporal Queries in an Extended Relational Database System," in *Second International Workshop on Research Issues of Data Engineering: Transaction and Query Processing*. Tempe, AZ: Feb. 1992.

Ling, D. H. O., D. A. Bell and I. R. Young. "A Temporal Database Management for Medical and Health Care Systems," in *Medical Informatics Europe*. Vienna, Austria: Aug. 1991, pp. 121–126.

Lorentzos, N. "DBMS Support for Non-Metric Measuring Systems." *IEEE Transactions on Knowledge and Data Engineering* (1992).

Lorentzos, N. A. "A Formal Extension of the Relational Model for the Representation of Generic Intervals." PhD. Dissertation. Birkbeck College, 1988.

Lorentzos, N. A. and R. G. Johnson. "Requirements Specification for a Temporal Extension to the Relational Model." *Data Engineering*, 11, No. 4 (1988), pp. 26–33.

Lorentzos, N. A. "Management of Intervals and Temporal Data in the Relational Model." Technical Report 49. Agricultural University of Athens. 1991.

Lorentzos, N. A. "Axiomatic Generalization of the Relational Model to Support Valid Time Data," in *Proceedings of the International Workshop on an Infrastructure for Temporal Databases*. Arlington, TX: June 1993.

Maiocchi, R. and B. Pernici. "Temporal Data Management Systems: A Comparative View." *IEEE Transactions on Knowledge and Data Engineering*, 3, No. 4, Dec. 1991, pp. 504–524.

Maiocchi, R., B. Pernici and F. Barbic. "Automatic Deduction of Temporal Information." *ACM Transactions on Database Systems*, 17, No. 4 (1992).

Manolopoulos, Y. and G. Kapetanakis. "Overlapping B+trees for Temporal Data," in *Proceedings of the 5th JCIT*. Jerusalem, Israel: Oct. 1990.

McKenzie, E. and R. Snodgrass. "An Evaluation of Relational Algebras Incorporating the Time Dimension in Databases." *ACM Computing Surveys*, 23, No. 4, Dec. 1991, pp. 501–543.

Montanari, A. and B. Pernici. "Towards a Temporal Logic Reconstruction of Temporal Databases," in *Proceedings of the International Workshop on an Infrastructure for Temporal Databases*. Ed. R. T. Snodgrass. Arlington, TX: June 1993.

Montanari, A. and B. Pernici. "Temporal Reasoning," in Temporal Databases: Theory, Design, and Implementation. Benjamin/Cummings, 1993. Chap. 21, pp. 534–562.

Nair, S. and S. Gadia. "Algebraic Optimization in a Relational Model for Temporal Databases." Technical Report TR-92-03. Computer Science Department, Iowa State University. May 1992, 20 pages.

Nair, S. and S. Gadia. "Algebraic Optimization in a Relational Model for Temporal Databases," in *Proceedings of the International Workshop on an Infrastructure for Temporal Databases*. Ed. R. T. Snodgrass. Arlington, TX: June 1993.

Navathe, S. and R. Ahmed. "Temporal Extensions to the Relational Model and SQL," in Temporal Databases: Theory, Design, and Implementation. Benjamin/Cummings, 1993. Chap. 4, pp. 92–109.

Orci, T. "Temporal Reasoning and Data Bases." PhD. Dissertation. Dept. of Computer and Systems Science, Stockholm University, 1993.

Orgun, M. A. "A Relational Algebra as a Query Language for Temporal Datalog," in *Proceedings of the 3rd International Conference on Database and Expert Systems Applications*. DEXA. DEXA, 1992.

Pissinou, N. "A Conceptual Framework for Time in Object Databases." Technical Report CRI-90-26. Computer Research Institute, University of Southern California. 1990.

Pissinou, N. "Extending the 3dis to Support Time." Technical Report CRI-91-1. Computer Research Institute, University of Southern California. 1991.

Pissinou, N. "Time in Object Databases." PhD. Dissertation. Computer Research Institute, University of Southern California, December 1991.

Pissinou, N. and K. Makki. "T-3dis: An Approach to Temporal Object Databases," in *Proceedings of the International Conference on Information and Knowledge Management*. 1992.

Pissinou, N. and K. Makki. "A Framework for Temporal Object Database Models," in Advances in Computer Sciences. Springer-Verlag, 1993.

Pissinou, N. and K. Makki. "A Storage Organization for Temporal Databases." *International Journal of Systems and Sciences*, (to appear) (1993).

Pissinou, N. and K. Makki. "A Unified Model and Methodology for Temporal Object Databases." *International Journal on Intelligent and Cooperative Information Systems*, (to appear) (1993).

Pissinou, N., K. Makki and Y. Yesha. "Research Perspective on Time in Object Databases," in *Proceedings of the International Workshop on an Infrastructure for Temporal Databases*. Ed. R. T. Snodgrass. Arlington, TX: June 1993.

Ramamritham, K. "Time for Real-Time Temporal Databases?," in *Proceedings of the International Workshop on an Infrastructure for Temporal Databases*. Ed. R. T. Snodgrass. Arlington, TX: June 1993.

Robertson, C. J. and J. R. McDonald. "Bring a Transformation to Temporal Databases." *New Zealand Journal of Computing*, 4, No. 2 (1993).

Roddick, J. "Incorporating Temporal Semantics into Behavioural Database Systems." Master's Thesis, Deakin University, 1990.

Roddick, J. and J. Patrick. "Adding Temporal Support to the RM/T Model," in Databases in the 1990s. World Scientific Publishing Co., 1991. Vol. 2. pp. 45–57.

Roddick, J. and J. Patrick. "Temporal Semantics - A Survey." Technical Report 1/91. Deakin University. 1991.

Roddick, J. F. and J. D. Patrick. "Adding Temporal Support to the RM/T Model," in Databases in the 1990s: 2. World Scientific Publishing Co., 1991. pp. 112–123.

Rose, E. and A. Segev. "TOODM - A Temporal Object-Oriented Data Model with Temporal Constraints," in *Proceedings of the 10th International Conference on the Entity Relationship Approach*. Oct. 1991.

Rose, E. and A. Segev. "TO-Algebra — A Temporal Object-Oriented Algebra." Technical Report LBL-32013. University of California, Berkeley. Jan. 1992.

Rose, E. and A. Segev. "A Temporal Object-Oriented Algebra and Data Model." Technical Report LBL-32013. Lawrence Berkeley Laboratory. 1992.

Rose, E. and A. Segev. "TOOA: A Temporal Object-Oriented Algebra," in *Proceedings of the European Conference on Object-Oriented Programming*. 1993.

Rose, E. and A. Segev. "TOOSQL – A Temporal Object-oriented Query Language," in *Proceedings of the 10th International Conference on the Entity-Relationship Approach*. Dallas, TX: 1993.

Rose, E. and A. Segev. "A Temporal Object-Oriented Query Language and Algebra." Technical Report LBL. Lawrence Berkeley Laboratory. 1993.

Ryu, K. H. "A Temporal Database Management Main Memory Prototype." TempIS Technical Report 26. University of Arizona. July 1991.

Ryu, K. H. "Users Manual and Tutorial for TempIS User Interface." TempIS Technical Report 27. University of Arizona. July 1991.

Sarda, N. L. "Recent Trends in Historical Databases," in *International Conference on Information Systems and Management of Data (CISMOD'92)*. Bangalore, India: July 1992, pp. 205–226.

Scalas, M. R. and P. Tiberio. "Integration of Temporal Versions of Data for Management of Knowledge Dynamics in PRO-COM (Prometheus)," in *4th Meeting on Radiomobile Systems*. Pontecchio Marconi, Italy: October 1988, pp. 7–22.

Scalas, M. R., A. Cappelli and C. De Castro. "A Model for Schema Evolution in Temporal Relational Databases," in *7th IEEE COMPEURO Annual European Computer Conference*. Paris-Evry, France: May 1993, pp. 223–231.

Segev, A. "Database Support for Temporal Queries," in *International Workshop on Nonstandard Queries and Answers Approach*. Tolouse, France: 1991, pp. 157–176.

Segev, A. and R. Chandra. "A Data Model for Time-Series Analysis," in Lecture Notes in Computer Science. Springer Verlag, 1992.

Segev, A. "Join Processing and Optimization in Temporal Relational Databases," in Temporal Databases: Theory, Design, and Implementation. Benjamin/Cummings, 1993. Chap. 15, pp. 356–387.

Segev, A. and A. Shoshani. "A Temporal Data Model Based on Time Sequences," in Temporal Databases: Theory, Design, and Implementation. Benjamin/Cummings, 1993. Chap. 11, pp. 248–270.

Segev, A., G. Himawan, R. Chandra and J. Shanthikumar. "Selectivity Estimation of Temporal Data Manipulations." *Information Sciences*, 74, No. 1-2, Oct. 1993.

Snodgrass, R., S. Gomez and E. McKenzie. "Aggregates in the Temporal Query Language TQuel." *IEEE Transactions on Knowledge and Data Engineering*, (to appear) (1993).

Snodgrass, R. T. "An Overview of TQuel," in Temporal Databases: Theory, Design, and Implementation. Benjamin/Cummings, 1993. Chap. 6, pp. 141–182.

Soo, M. D. "Multiple Calendar Support for Conventional Database Management Systems," in *Proceedings of the Workshop on an Infrastructure for Temporal Databases*. Ed. R. T. Snodgrass. June 1993, pp. FF1–FF17.

Sripada, S. M. "Design of the ChronoBase Temporal Deductive Database System," in *Proceedings of the International Workshop on an Infrastructure for Temporal Databases*. Ed. R. T. Snodgrass. Arlington, TX: June 1993.

Su, S. Y. W. and H. H. Chen. "Modeling and Management of Temporal Data in Object-oriented Knowledge Bases," in *Proceedings of the Workshop on an Infrastructure for Temporal Databases*. Ed. R. T. Snodgrass. Arlington, TX: June 1993.

Su, S. Y. W. and H. H. Chen. "Temporal Rule Specification and Managment in Object-oriented Knowledge Bases," in *Proceedings of the First International Workshop on Rules in Database Systems*. Edingburgh, Scotland: Aug. 1993.

Tansel, A. "A Historical Query Language." *Information Sciences*, No. 53 (1991), pp. 101–133.

Tansel, A. "A Generalized Relational Framework for Modeling Temporal Data," in Temporal Databases: Theory, Design, and Implementation. Benjamin/Cummings, 1993. Chap. 7, pp. 183–201.

Tansel, A. "SQL-T: A Temporal Extension to SQL," in *Proceedings of the International Workshop on an Infrastructure for Temporal Databases*. Ed. R. T. Snodgrass. Arlington, TX: June 1993.

Tansel, A., J. Clifford, S. Gadia, S. Jajodia, A. Segev and R. Snodgrass (eds.). "Temporal Databases: Theory, Design, and Implementation." Database Systems and Applications Series. Redwood City, CA: Benjamin/Cummings, 1993.

Tansel, A. U. "Temporal Relational Data Model." Technical Report. Baruch College, CUNY. 1991.

Theodoulidis, B., B. Wangler and P. Loucopoulos. "Requirements Specification in TEMPORA," in *2nd Nordic Conference on Advanced Information Systems Engineering*. CAiSE90. Kaisa, Sweden: 1990.

Theodoulidis, B., P. Loucopoulos and B. Wangler. "The Entity Relationship Time Model," in Conceptual Modelling, Databases, and CASE: An Integrated View of Information Systems Development. John Wiley, 1992.

Theodoulidis, C. "Towards the First Generation of Temporal Information Servers," in *Proceedings of the International Workshop on an Infrastructure for Temporal Databases*. Ed. R. T. Snodgrass. Arlington, TX: June 1993.

Tuma, Paul Anye "Implementing Historical Aggregates in TempIS." Master's Thesis, Wayne State University, 1993.

Tuzhilin, A. "Using Relational Discrete Event Systems and Models for Predication of Future Behavior of Databases." PhD. Dissertation. New York University, Oct. 1989.

Tuzhilin, A. "Applications of Temporal Databases to Knowledge-based Simulations," in Temporal Databases: Theory, Design, and Implementation. Benjamin/Cummings, 1993. Chap. 23, pp. 581–593.

Vassilis, J. T., B. Gopinath and G. W. Hart. "Efficient Management of Time-Evolving Databases." *Topics on Data Engineering* (1994).

Wang, X. and S. Jajodia. "Temporal Mediators as a Way to Support Multiple Temporal Representations," in *Proceedings of the International Workshop on an Infrastructure for Temporal Databases*. Ed. R. T. Snodgrass. Arlington, TX: June 1993.

Wang, X., S. Jajodia and V. Subrahmanian. "Temporal Modules: An Approach Toward Temporal Databases," in *Proceedings of SIGMOD Conference*. 1993, pp. 227–236.

Weiderhold, G., S. Jajodia and W. Litwin. "Integrating Temporal Data in a Heterogeneous Environment," in Temporal Databases: Theory, Design, and Implementation. Benjamin/Cummings, 1993. Chap. 22, pp. 563–579.

Wells, D. "Exploring the Possibility of Time as a Seamless Database Extension," in *Proceedings of the International Workshop on an Infrastructure for Temporal Databases*. Ed. R. T. Snodgrass. Arlington, TX: June 1993.

Wiederhold, G., S. Jajodia and W. Litwin. "Dealing with Granularity of Time in Temporal Databases," in *Proc. 3rd Nordic Conf. on Advanced Information Systems Engineering*. Trondheim, Norway: May 1991.

Wiederhold, G. "The Need to Harmonize Temporal Data Models," in *Proceedings of the International Workshop on an Infrastructure for Temporal Databases*. Ed. R. T. Snodgrass. Arlington, TX: June 1993.

Wuu, G. "SERQL: An ER Query Language Supporting Temporal Data Retrieval," in *Proceedings of the 10th International Phoenix Conference on Computers and Communications*. Mar. 1991, pp. 272–279.

Wuu, G. and U. Dayal. "A Uniform Model for Temporal Object-Oriented Databases," in *Proceedings of the International Conference on Data Engineering*. Tempe, Arizona: Feb. 1992, pp. 584–593.

Wuu, G. and U. Dayal. "A Uniform Model for Temporal and Versioned Object-oriented Databases," in Temporal Databases: Theory, Design, and Implementation. Benjamin/Cummings, 1993. Chap. 10, pp. 230–247.

Yan-Zhen, Qu, F. Sadri and P. Goyal. "Temporal Object-Oriented Database: Implementation," in *Proceedings of the 3rd International Conference on Database and Expert Systems Applications*. 1992.

Yau, C. and G. S. W. Chat. "TempSQL – A Language Interface to a Temporal Relational Model." *Information Sc. & Tech.*, Oct. 1991, pp. 44–60.

Yoo, H. "A Design and Implementation of Temporal Query Language with Abstract Time Support." Master's Thesis, KAIST, 1987.

5 Other Papers

Papers in this section are not easily classified according to their use of valid or transaction time. Some of these papers discuss various types of versioning for object-oriented databases, or Non-First Normal Form relational databases. Additional papers concern different aspects of temporal databases, such as how to perform calculations on timestamps.

Allen, J. "Time and Time Again: the Many Ways to Represent Time." *International Journal of Intelligent Systems*, 6, No. 4, November 1991, pp. 341–355.

Baudinet, M., M. Niézette and P. Wolper. "On the Representation of Infinite Temporal Data and Queries (Extended Abstract)," in *Proceedings of the ACM Symposium on Principles of Database Systems*. Association for Computing Machinery. Denver, CO: May 1991, pp. 280–290.

Bhargava, G. and S. K. Gadia. "The Concept of Error in a Database: An Application of Temporal Databases," in *Proceedings of 1990 COMAD International Conference on Management of Data*. Ed. N. Prakash. New Delhi: Tata McGraw-Hill, Dec. 1990, pp. 106–121.

Bhargava, G. and S. K. Gadia. "Relational Database Systems with Zero Information Loss." *IEEE Transactions on Knowledge and Data Engineering*, 5, No. 1, Feb. 1993, pp. 76–87.

Böhlen, M. and R. Marti. "Handling Temporal Knowledge in a Deductive Database System," in Datenbanksysteme in Büro, Technik und Wisenschaft. Springer-Verlag, 1993.

Chakravarthy, S. and S.-K. Kim. "Resolution of Time Concepts in Temporal Databases." UF-CIS Tech. Report 93-004. Database Systems R&D Center, CIS Department, University of Florida. January 1993.

Chakravarthy, S. and D. Mishra. "Snoop: An Expressive Event Specification Language for Active Databases." Technical Report UF-CIS-TR-93-007. University of Florida. Mar. 1993.

Chandra, R., A. Segev and M. Stonebraker. "Implementing Calendars and Temporal Rules in Next Generation Databases," in *Proceedings of the International Conference on Data Engineering*. 1994.

Chazelle, B. "How to Search in History." *Information and Control*, 64 (1985), pp. 77–99.

Chomicki, J. and T. Imelinski. "Finite Representation of Infinite Query Answers." Technical Report TR-CS-90-10. Kansas State University. Aug. 1990.

Chomicki, J. "History-less Checking of Dynamic Integrity Constraints," in *Proceedings of the International Conference on Data Engineering*. Ed. F. Golshani. Los Alamitos, CA: IEEE Computer Society Press, Feb. 1992, pp. 557–564.

Chomicki, J. "Real-Time Integrity Constraints." Technical Report TR-CS-92-26. Department of Computing & Information Sciences, Kansas State University. Apr. 1992, 9 pages.

Chomicki, J. and D. Niwinski. "On the Feasibility of Checking Temporal Integrity Constraints," in *Proceedings of the ACM SIGACT-SIGMOD Symposium of PODS*. 1993, pp. 202–213.

Corsetti, E., E. Montanari and E. Ratto. "Dealing with Different Time Granularities in Formal Specifications of Real-Time Systems." *Journal of Real-Time Systems*, June 1991.

Dershowitz, N. and E. M. Reingold. "Calendrical Calculations." *Software–Practice and Experience*, 20, No. 9, Sep. 1990, pp. 899–928.

Dyreson, C. "A Proposed Timestamp Format," in *Proceedings of the International Workshop on an Infrastructure for Temporal Databases*. Ed. R. T. Snodgrass. Arlington, TX: June 1993.

Dyreson, C. E. and R. T. Snodgrass. "Timestamp Semantics and Representation." *Information Systems*, 18, No. 3 (1993), pp. 143–166.

Dyreson, C. E. and R. T. Snodgrass. "Efficient Timestamp Input/Output." *Software–Practice and Experience*, (to appear) (1993).

Dyreson, C. E., R. T. Snodgrass and C. S. Jensen. "On the Semantics of "Now" in Temporal Databases." TempIS Technical Report 42. Computer Science Department, University of Arizona. April 1993, 22 pages.

Edelweiss, N., B. Pernici, J. de Oliveira and J. de Castilho. "Extending an Object Oriented Model to Represent Temporal Requirements," in *International Conference of the SCCC*. Santiago, Chile: October 1992, pp. 11–25.

Etzion, O., A. Gal and A. Segev. "A Temporal Active Database Model." Technical Report LBL 32587. Lawrence Berkeley Laboratory. 1992, 31 pages.

Etzion, O., A. Gal and A. Segev. "Temporal Support in Active Databases," in *Proceedings of the Second International Workshop on Technologies and Systems (WITS)*. Dallas. Texas: Dec. 1993.

Etzion, O., A. Gal and Segev A.. "Data Driven and Temporal Rules in PARDES," in *Proceedings of the Workshop on Rules in Databases*. Edinburgh, Scotland: Aug. 1993.

Falkenberg, E. D., J. L. H. Oei and H. A. Proper. "Evolving Information Systems: Beyond Temporal Information Systems," in *Proceedings of the 3rd International Conference on Database and Expert Systems Applications*. 1992.

Gehani, N., H. V. Jagadish and O. Shmueli. "Event Specification in an Active Object-Oriented Database," in *Proceedings of ACM SIGMOD International Conference on Management of Data*. San Diego, CA: June 1992, pp. 81–90.

Gehani, N., H. V. Jagadish and O. Shumueli. "Composite Event Specification in Active Databases," in *Proceedings of the Conference on Very Large Databases*. Vancouver, Canada: Aug. 1992.

Georgakopoulos, D., M. Rusinkiewicz and W. Litwin. "Chronological Scheduling of Transactions with Temporal Dependencies." *VLDB Journal* (1992).

Goldring, R. "An Introduction to Time-series Data." *Information DB*, 7, No. 2 (1993), pp. 22–25.

Haghighi, N. and S. H. Son. "Multiple Data Versions in Database Systems." Technical Report TR-89-01. University of Virginia. June 1989, 1–44 pages.

Harel, E., O. Lichtenstein and A. Pnueli. "Explicit-clock Temporal Logic," in *Proceedings of the Fifth IEEE Symposium on Logic in Computer Science*. 1990.

Ioannidis, E., S. Kokkotos and C. Spyrooulos. "A Temporal Framework for Managing Retroactive and Delayed Updates: an Application to the Payroll Information System of the Greek Public Sector." *European Journal of Information Systems*, 2, No. 2, Apr. 1993.

Jagadish, H. V., I. Mumick and O. Shmueli. "Events with Attributes in an Active Database." Technical Report Technical Report 921214-18-TM. AT&T Bell Laboratories. Dec. 1992.

Jensen, C. S., J. Clifford, S. K. Gadia, A. Segev and R. T. Snodgrass. "A Glossary of Temporal Database Concepts." *SIGMOD Record*, 21, No. 3, Sep. 1992, pp. 35–43.

Johnson, R. G. and N. A. Lorentzos. "Comments on 'Extensions to SQL for Historical Databases'." *IEEE Transactions on Knowledge and Data Engineering*, 4, No. 4 (1992).

Käfer, W. "History and Version Management of Complex Objects (in German)." PhD. Dissertation. Fachbereich Informatik, University Kaiserslautern, 1992.

Käfer, W. and H. Schoening. "Mapping a Version Model to a Complex-Object Data Model," in *Proceedings of International Conference on Data Engineering*. Tempe, Arizona: Feb. 1992, pp. 348–357.

Kandrashina, E. Yu "Representation of Temporal Knowledge," in *International Joint Conference on Artificial Intelligence*. W. Germany: 1983, pp. 346–348.

Kedem, Z. M. and A. Tuzhilin. "Relational Database Behavior: Utilizing Relational Discrete Event Systems and Models," in *Proceedings of the ACM Symposium on Principles of Database Systems*. 1989.

Keretho, S. and R. Loganantharaj. “An Interval Arithmetic for Temporal Distance Constraint Satisfaction Problems.” Technical Report CACS TR-90-2-2. University of Southwestern Louisiana. Apr. 1990.

Keretho, S. and R. Loganantharaj. “An Extended Time Point Algebra.” Technical Report CACS TR-90-2-3. University of Southwestern Louisiana. June 1990.

Kline, N. “Specifying Multiple Calendars, Calendric Systems, and Field Functions and Tables in MultiCal.” TempIS Technical Report 46. Computer Science Department, University of Arizona. April 1993.

Kline, N. “The Gregorian Calendar Specification.” TempIS Technical Report 47. Computer Science Department, University of Arizona. April 1993.

Knight, B. and M. Jixin. “An Extended Temporal System based on Points and Intervals.” *Information Systems*, 18, No. 2, Mar. 1993, pp. 111-120.

Ling, D. H. O. and D. A. Bell. “Taxonomy of time models in databases.” *Information and Software Technology*, 32, No. 3, Apr. 1990, pp. 215–224.

Little, T. D. C. and A. Ghafoor. “Interval-Based Conceptual Models for Time-Dependent Multimedia Data.” *IEEE Transactions on Knowledge and Data Engineering*, 5, No. 4, August 1993, pp. 551–563.

Lorentzos, N. A. “DBMS Support for Time and Totally Ordered Compound Data Types.” Technical Report. Informatics Labratory, Agricultural University of Athens. 1991.

Manolopoulos, Y. “Reverse Chaining for Answering Temporal Logical Queries.” *The Computer Journal*, (to appear) (1991).

Montanari, A., E. Maim, E. Ciapessoni and E. Ratto. “Dealing with Time Granularity in the Event calculus,” in *Proceedings of the International Conference on Fifth Generation Computer Systems 1992*. ICOT. Tokyo, Japan: June 1992, pp. 702–712.

Mylopoulos, J., A. Borgida, M. Jarke and M. Koubarakis. “Telos: A Language for Representing Knowledge About Information Systems (Revised).” Technical Report KRR-TR-89-1. University of Toronto. Aug. 1990, 48 pages.

Nakamura, Y., S. Abe, Y. Ohsawa and M. Sakauchi. “A Balanced Hierarchical Data Structure for Multidimensional Data with Highly Efficient Dynamic Characteristics.” *IEEE Transactions on Knowledge and Data Engineering*, 5, No. 4, August 1993, pp. 682–694.

Oelmann, A. “Representing a System Specification with a Temporal Dimension in an Object-oriented Language,” in *Proceedings of CAiSE '91*. Trondheim, Norway: May 1991, pp. 540–560.

Oomoto, E. and K. Tanaka. “OVID: Design and Implementation of a Video-Object Database System.” *IEEE Transactions on Knowledge and Data Engineering*, 5, No. 4, August 1993, pp. 629–643.

Pernici, B. and M. Pezze. “Temporal Analysis of Office Procedure.” Technical Report. CEFRIEL Report. 1989.

Pinciroli, F., C. Combi and G. Pozzi. “Object-oriented DBMS Techniques for Time-orientated Medical Record.” *Medical Informatics*, 17, No. 4 (1992), pp. 231–241.

Pinciroli, F., C. Combi and G. Pozzi. “An Object-oriented Approach Towards Integration of Temporally-oriented Medical Data and Images,” in *MEDINFO 92: Proceedings of the Seventh World Congress on Medical Informatics*. Geneva, Switzerland: Sep. 1992, pp. 131–137.

Reingold, E. M., S. M. Clamen and N. Dershowitz. “Calendrical Calculations Part II: Three Historical Calendars.” *Software–Practice and Experience*, 23 (1993), pp. 899–928.

Roddick, J. F. and J. D. Patrick. “Temporal Semantics in Information Systems – A Survey.” *Information Systems*, 17, No. 3, Oct. 1992, pp. 249–267.

Schiel, U. “An Open Environment for Objects with Time and Versioning,” in *Proceedings of the East-European Conference on Object Oriented Programming (EastEurOOPe)*. Bratislava: 1991.

Schreiber, F. A. “Is Time A Real Time? An Overview of Time Ontology in Informatics.” Technical Report 92-046. Dipartimento di Elettronica e Informazione, Politecnico di Milano. 1992.

Sciore, E. “Using Annotations to Support Multiple Kinds of Versioning in an Object-Oriented Database System.” *ACM Transactions on Database Systems*, 16, No. 3, Sep. 1991, pp. 417-438.

Sciore, E. “Versioning and Configuration management in an Object-Oriented Data Model.” Technical Report BCCS 91-12 revised. Computer Science Department, Boston College. 1991.

Sciore, E. “Multidimensional Versioning for Object-Oriented databases.” *Proc. Second International Conf. on Deductive and Object-Oriented Databases*, Dec. 1991.

Sheng, R. L. “A Linguistic Approach to Temporal Information Analysis.” PhD. Dissertation. University of California, Berkeley, 1983.

Song, X. and J. W. S. Liu. "How Well Can Data Temporal Consistency be Maintained," in *Proceedings of the IEEE Symposium on Computer-Aided Control Systems Design*. 1992.

Soo, M. D. "Bibliography on Temporal Databases." *ACM SIGMOD Record*, 20, No. 1, Mar. 1991, pp. 14–23.

Soo, M. D. and R. Snodgrass. "Multiple Calendar Support for Conventional Database Management Systems." Technical Report 92-7. Computer Science Department, University of Arizona. Feb. 1992, 17 pages.

Soo, M. D. and R. Snodgrass. "Mixed Calendar Query Language Support for Temporal Constants." TempIS Technical Report 29. Computer Science Department, University of Arizona. Revised May 1992, 59 pages.

Soo, M. D., R. Snodgrass, C. Dyreson, C. S. Jensen and N. Kline. "Architectural Extensions to Support Multiple Calendars." TempIS Technical Report 32. Computer Science Department, University of Arizona. Revised May 1992, 30 pages.

Theodoulidis, B., P. Loucopoulos and V. Kopanas. "A Rule-oriented Formalism for Active Temporal Databases," in *Next Generation CASE Tools*. Trondheim, Norway: May 1991, pp. 144–166.

Theodoulidis, B., P. Alexakis and P. Loucopoulos. "Verification and Validation of Temporal Business Rules," in *Proceedings of the 3rd International Workshop on the Deductive Approach to Information Systems and Databases*. Roses (Catalonia), Spain: September 1992.

Theodoulidis, C., P. Loucopoulos and B. Wangler. "The Entity Relationship Time Model and the Conceptual Rule Language," in *The 10th International Conference on the Entity Relationship Approach*. San Mateo, California: E/R Institute, Oct. 1991, pp. 181–204.

Theodoulidis, C. I. and P. Loucopoulos. "The Time Dimension in Conceptual Modelling." *Information Systems*, 16, No. 3 (1991), pp. 273–300.

Theodoulidis, C. I. and B. Wangler. "A Conceptual Modelling Formalism for Temporal Database Applications." *Information Systems*, 16, No. 4 (1991), pp. 401–416.

Thompson, P. M. "A Temporal Data Model Based on Accounting Principles." PhD. Dissertation. Department of Computer Science, University of Calgary, Mar. 1991.

Tsotras, J., B. Gopinath and G. Hart. "Efficient Management of Time-Evolving Databases." *IEEE Transactions on Knowledge and Data Engineering*, (to appear) (1993).

Tsotras, V. J. and B. Gopinath. "Optimal Versioning of Object Classes," in *Proceedings of the International Conference on Data Engineering*. Ed. F. Golshani. Los Alamitos, CA: IEEE Computer Society Press, Feb. 1992, pp. 358–365.

Wilson, P. R. and T. G. Moher. "Demonic Memory for Process Histories," in *ACM SIGPLAN Notices*. Portland, Oregon: July 1989, pp. 330-343.

Winskel, G. "An Introduction to Event Structures," in Linear Time, Branching Time, and Partial Order in Logics and Models for Concurrency. Vol. 354 of Lecture Notes in Computer Science. Bratislava: Springer-Verlag, 1989. pp. 364–397.

Zarri, G. "Formalizing Temporal Issues in the Framework of the Descriptive Component of a Knowledge Representation Language," in *International Association of Knowledge Engineers*. College Park, MD: June 1989, pp. 585–600.