

Spatial Data Management for Virtual Product Development

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Abstract: In the automotive and aerospace industry, millions of technical documents are generated during the development of complex engineering products. Particularly, the universal application of Computer Aided Design (CAD) from the very first design to the final documentation created the need for transactional, concurrent, reliable, and secure data management. The huge underlying CAD databases, occupying terabytes of distributed secondary and tertiary storage, are typically stored and referenced in Engineering Data Management systems (EDM) and organized by means of hierarchical product structures. Although most CAD files represent spatial objects or contain spatially related data, existing EDM systems do not efficiently support the evaluation of spatial predicates. In this paper, we introduce spatial database technology into the file-based world of CAD. As we integrate 3D spatial data management into standard object-relational database systems, the required support for data independence, transactions, recovery, and interoperability can be achieved. Geometric primitives, transformations, and operations on three-dimensional engineering data will be presented which are vital contributions to spatial data management for CAD databases. Furthermore, we will present an effective and efficient approach to spatially index CAD data by using the concepts of object-relational database systems and the techniques of relational access methods. The presented techniques are assembled to a complete system architecture for the Database Integration of Virtual Engineering (DIVE). By using relational storage structures, the DIVE system provides three-dimensional spatial data management within a commercial database system. The spatial data management and the query processor is fully embedded into the Oracle8i server and has been evaluated in an industrial environment. Spatial queries on large databases are performed at interactive response times.