Polynomial Spatial Constraint Databases

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SYNONYMS

Constraint Database Systems; Constraint Query Languages; Infinite Relational Databases; Linear Constraint Databases; Moving Object Constraint Databases; Spatiotemporal Constraint Databases

DEFINITION

The framework of constraint databases provides a general model for spatial databases [4]. In the constraint model, a *polynomial spatial constraint database* contains a finite number of relations, that, although conceptually viewed as possibly infinite sets of points in some real space $\mathbf{R}^n$, are represented as a finite union of systems of polynomial equations and inequalities.

MAIN TEXT

More specifically, in a *polynomial spatial constraint database*, a relation is defined as a boolean combination (union, intersection, complement) of subsets of some real space $\mathbf{R}^n$ (in applications, typically $n = 2$ or 3) that are definable by polynomial constraints of the form $p(x_1, ..., x_n) \geq 0$, where p is a polynomial in the real variables $x_1, ..., x_n$ with integer coefficients. For example, the spatial relation consisting of the set of points on the upper half of the unit disk in $\mathbf{R}^2$ can be represented by the formula $x^2 + y^2 \leq 1 \wedge y \geq 0$. In practice, spatial relations will occur extended with thematic alpha-numeric information, like a name. In mathematical terminology, these spatial relations are known as *semi-algebraic* sets and their properties have been studied extensively [1].
The polynomial constraint database model was introduced by Kanellakis, Kuper, and Revesz [2] in 1990. The application of this model to spatial databases was described by Paredaens, Van den Bussche, Van Gucht [4]. This model was studied extensively in the 1990s and a state of the art book "Constraint databases," edited by G. Kuper, L. Libkin, J. Paredaens appeared in 2000 [3]. and the textbook "Introduction to Constraint Databases" by P. Revesz was published in 2002 [5].

RECOMMENDED READING

[1] J. Bochnak, M. Coste, and M.-F. Roy. *Géométrie algébrique réelle*. Springer-Verlag, 1987.
[2] P. C. Kanellakis, G. Kuper, and P. Z. Revesz. Constraint query languages. *Journal of Computer and System Sciences*, 51:26–52, 1995.
[3] G. M. Kuper, L. Libkin, and J. Paredaens, editors. *Constraint Databases*. Springer-Verlag, 2000.
[4] J. Paredaens, J. Van den Bussche, and D. Van Gucht. Towards a theory of spatial database queries. In *Proceedings of the 13th ACM Symposium on Principles of Database Systems*, pages 279–288, 1994.
[5] R. Z. Revesz. *Introduction to Constraint Databases*. Springer-Verlag, 2002.