Solving Linear Graphical Constraint Expressions

Gerd Szwillus

Universität-GH-Paderborn, Fachbereich Mathematik/Informatik, Warburger Str. 100, D-4790 Paderborn, Germany
szwillus@uni-paderborn.de, Tel: ++49 5251 60-2077, Fax: ++49 5251 60-3836

Interactive application-specific graphics are considered to be one of the challenging current problems in user interface technology. Graphical constraints have been introduced as means to unburden the application from graphical representation details such as exact positions, sizes, widths, and directions. A severe problem in such a system is to strike the balance between the expressive power of the constraints and the evaluation speed of the solver. On one hand, the system must be very fast, to meet the needs and expectations of the interactive user. On the other hand, the constraints available in the system must be capable of describing all relevant "graphical rules" for the problem. One notes that most window managing systems are "rectangle-based," meaning that elements like active areas, menus, dialog-boxes, and so on, are defined as rectangles with their sides parallel to the axes of the window. This allows easy check and transformation operations and maps efficiently on the underlying hardware structures. Mathematically, this leads to linear dependencies as the elementary concept.

We present the Guarded Local Propagation (GLP) algorithm, which is capable of solving a large collection of constraints in very short time. This property renders it possible to use GLP for the description and fast automatic determination of user interface layouts as sketched out above. GLP is restricted to solving linear graphical constraint expressions. These are built from elementary linear constraints and the logical operations AND and OR. Although linear constraints in itself are conceptually simple, they already cover a great deal of what is needed for the specification of graphical "syntax rules," but their expressive power is enhanced by the possibilities of logical combination. The algorithm is fast, as it works without iterative methods and is highly directable during the value assignment phase, such that a very natural implementation of the "principal of least astonishment" is achieved. The user of the GLP algorithm can determine the order of definition of the variables contained in the constraint system, and in consequence has control over the new values to a high degree. In addition, values change only as little as possible. The poster discusses the power of linear constraint expressions, describes the concepts of the algorithm, and sketches out experiences with its use.