

Constraint Processing Over Decision Diagrams

This thesis is concerned with extending the BDD-based interactive product configuration framework to more advanced forms of decision support involving cost-based reasoning and involving application domains other than product manufacturing. The thesis is also concerned with extending the benefits of BDD technology to fundamental constraint programming tasks such as search and optimization.

We first suggest *cost-bounded configuration* and afterwards *cost-based domain analysis* as cost-based extensions of the basic BDD approach to interactive configuration. Our work on cost-bounded configuration delivers strong polynomial-time guarantees for the configuration instances that were previously handled in the standard configuration framework. The cost-based domain analysis however is concerned with the general *integer programming* (IP) models, where similar guarantees can not be delivered. The research into the practical compilation approaches for such domains is in its infancy, and as a step in this direction we suggest compiling BDDs only for the specially constructed supersets of near-optimal solutions.

Through our work on MDD-based constraint store, we demonstrate that the strengths of the BDD technology can indeed be used to enhance the fundamental constraint programming tasks, such as search and optimization. However, rather than using existing BDD technology as a black-box, we integrate it with constraint processing on a more refined level that led to promising computational improvements.

Processing constraints directly over decision diagrams lies at the heart of the cost-based enhancements of BDD-based configuration as well as the MDD-based constraint programming. While for the cost-based extensions the processing is limited to separable inequalities, in the work on MDD-based constraint store, processing of any type of CSP constraints over a decision diagram becomes the fundamental issue. In particular, propagation of the *alldiff* constraint over decision diagrams is developed and successfully implemented.

As conclusion, we claim that *processing constraints directly over BDD-based datastructures is beneficial both for extending the scope of BDD-based interactive configuration and for improving the performance of fundamental CSP reasoning tasks.*