Evaluating Consistency Algorithms for Temporal Metric Constraints

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Evaluating Consistency Algorithms for Temporal Metric Constraints
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Summary
Focus: Networks of temporal metric constraints
Task: Evaluating the performance of algorithms for
• Determining the consistency of the Simple Temporal Problem (STP).
• Finding the minimal network of the Temporal Constraint Satisfaction Problem (TCSP).
Future: Enhance triangulation-based algorithms with incrementality.

Networks of Temporal Metric Constraints

Temporal constraint network: a graph G=(V, E, I), where
• V: set of vertices representing time points
• E: set of directed edges representing constraints between two time points
• I: set of directed labels for the edges. A label is a set of intervals and an interval (a, b) denotes a constraint of bounded differences (a ≤ t < b)

Evaluating the performance of algorithms for
• Determining consistency of STP
• Finding the minimal network of TCSP

Constraint Checks
E: set of directed edges representing constraint between two time points
incBF outperforms ∆STP
0.1
0.5
Decomposes the graph into bi
0.7
NewCyc
Domains of variables: edge labels in the
allows dynamic updates for both constraint posting & retraction.
∆STP results in the minimal network &
Binds the total cost by the size of largest component.

Improving Search for the TCSP (Ku & Choueiry CP 03)

Improving the performance of BT-TCSP:
• AIC: an acyclicity finding algorithm for reducing the size of TCSP.
• Exploits the topology of the constraint graph:
• AP: using articulation points:
• NewCyc: a heuristic for avoiding unnecessary checking of STPs at every node.
• EdgeOrd: a variable ordering heuristic.

Advantages of AIC:
• It is effective, especially under high density.
• It is sound, cheap (O(EK3)), may be optimal.
• It uncovers a phase transition in TCSP.

Articulation Points (AP) exploits the topology of the graph
• Decomposes the graph into bi-connected components.
• Solves each of them independently.
• Binds the total size by the largest component.

Comparing the above strategies:

For STP:
• ∆STP outperforms all others
• incBF outperforms ∆STP

For TCSP:
• ∆STP outperforms all others
• incBF outperforms ∆STP

Conclusions

References

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Appendix

Constraint Checks

38.30
32.18
29.29
28.70
24.58
19.24
11.74
10.74
20.52
20.29
3.45
14.84

Constraint checks for selected STP solvers

For medium density values (0.1), it was impossible to find a solution.

For small density values (0.01), values of results are very small. We included number of samples up to 150,000 samples per point.