

**Hoffmann, J.**

**Analyzing search topology without running any search: on the connection between causal graphs and  $h^+$ .** (English) [Zbl 1218.68160](#)  
*J. Artif. Intell. Res. (JAIR)* 41, 155-229 (2011).

Summary: The ignoring delete lists relaxation is of paramount importance for both satisficing and optimal planning. In earlier work, it was observed that the optimal relaxation heuristic  $h^+$  has amazing qualities in many classical planning benchmarks, in particular pertaining to the complete absence of local minima. The proofs of this are hand-made, raising the question whether such proofs can be lead automatically by domain analysis techniques. In contrast to earlier disappointing results – the analysis method has exponential runtime and succeeds only in two extremely simple benchmark domains – we herein answer this question in the affirmative. We establish connections between causal graph structure and  $h^+$  topology. This results in low-order polynomial time analysis methods, implemented in a tool we call TorchLight. Of the 12 domains where the absence of local minima has been proved, TorchLight gives strong success guarantees in 8 domains. Empirically, its analysis exhibits strong performance in a further 2 of these domains, plus in 4 more domains where local minima may exist but are rare. In this way, TorchLight can distinguish “easy” domains from “hard” ones. By summarizing structural reasons for analysis failure, TorchLight also provides diagnostic output indicating domain aspects that may cause local minima.

**MSC:**

- [68T20](#) Problem solving in the context of artificial intelligence (heuristics, search strategies, etc.)
- [68Q17](#) Computational difficulty of problems (lower bounds, completeness, difficulty of approximation, etc.)
- [68R10](#) Graph theory (including graph drawing) in computer science
- [68-04](#) Software, source code, etc. for problems pertaining to computer science

Cited in **2** Documents

**Software:**

[TorchLight](#); [Graphplan](#)

**Full Text:** [DOI](#) [arXiv](#)