Concurrent forward bounding for distributed constraint optimization problems

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A distributed search algorithm for solving Distributed Constraints Optimization Problems (DCOPs) is presented. The new algorithm scans the search space by using multiple search processes (SPs) that run on all agents concurrently. SPs search in non-intersecting parts of the global search space and perform Branch & Bound search. Each search process (SP) uses the mechanism of forward bounding (FB) to prune efficiently its part of the global search space. The Concurrent Forward-Bounding (ConcFB) algorithm enables all SPs to share their upper bound across all parts of the global search space. The number of concurrent SPs is controlled dynamically by the ConcFB algorithm, by performing dynamic splitting. Within each SP a dynamic variable ordering is employed in order to help control the balance of computational load among all agents and across different SPs. The ConcFB algorithm is evaluated experimentally and compared to all state of the art DCOP algorithms. The number of Non-Concurrent Logical Operations, Non-Concurrent Steps, the total number of messages sent and CPU time are used as performance metrics. The evaluation procedure considers different DCOP problem types with a varying number of agents and different constraint graphs. As problems become larger and denser, ConcFB is shown to outperform all other evaluated algorithms by 2–3 orders of magnitude in all performance measures. Further evaluations comparing different variants of ConcFB provide important insights into the working of the algorithm and reveals the contribution of its different components.

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