REVIEW

OPTIMISTICALLY PARALLELIZING PARALLEL SEARCH PROCESSES

Optimistische verteilte Spielbaumsuche am Beispiel des Computerschachs
Kai Himstedt
PhD Thesis, Universität Hamburg, 2011, 258 pp.
Shaker Verlag, Aachen
ISBN 978-3-8440-0803-6
€ 45.80 (paper); € 11.45 (pdf)

Reviewed by Dap Hartmann

Computer chess programs search the game tree emerging from the root which is the current board position in which it must make a move. Because the average branching factor in a typical middle game position is about 40, the search process would appear to be ideally suited for massive parallelism. However, the clever alpha-beta algorithm which reduces the search effort tremendously in well-sorted trees spoils the party because it requires communication of intermediate search results between the various branches. That poses no problems in a sequential search process where searching the next branch cannot commence until the search of the previous branch has finished. But in a parallel search process it is a serious problem. To overcome this, Rainer Feldman in the late 1980s developed the Young Brothers Wait Concept (YBWC) in which the use of parallelism is delayed until the necessary subtrees have been searched and their results are available to the main search. Specifically, in each node the search of the 'eldest brother' has to be completed while the 'young brothers' wait – hence the name. Although the YBWC delays the search (by stalling individual processors) it does achieve a net increase in search efficiency because it prevents the search of irrelevant subtrees and reduces the search overhead. The use of the YBWC is now state of the art in parallelizing the game-tree searching on a single computer cluster. Yet, adding more computers to the cluster will not improve the speed of the search beyond a certain point. Apparently, this law of diminishing returns is still a matter of hot debate. At least, according to this thesis in which the phrase 'diminishing returns' occurs 22 times and often in combination with doubt-inspiring qualifications such as *vermeintliche Beobachtung* (alleged observation), *die Existenz von* (the existence of) and *möglicherweise* (possibly).

For his PhD research, Kai Himstedt experimented with a dual distributed game-tree search method which combines the Young Brothers Wait Concept (YBWC) implemented on individual computer clusters with the Optimistic Pondering principle applied to the collected clusters. Optimistic Pondering is a sophisticated strategy of 'thinking ahead' in the opponent's time, using a parallel approach of searches starting from different positions in the principal variation. In some cases the system actually 'thinks ahead' in its own time. Himstedt implemented this approach in his chess program GRIDCHESS which is organized as a group of individual computer clusters (which Himstedt calls 'workers') that parallalize the search using Optimistic Pondering. Each 'worker' is a cluster which runs a YBWC implementation of a modified version of Fabien Letouzey's strong freeware chess program FRUIT. A big advantage of this approach is that Optimistic Pondering does not require a large bandwidth for communicating between the clusters, and so the clusters could be located in different places.

The thesis is well structured and tells a complete story, which makes it a pleasure to read. In Chapter 1, Himstedt explains the motivation for his research and outlines the rest of the thesis. Chapter 2 (*Spekulativität in Verfahren zur Parallelisierung der Spielbaumsuche*) presents a good review of the literature on speculative computing in parallel tree searching. Chapter 3 is the highlight of the thesis. It explains in great detail the Optimistic Pondering strategy and convincingly shows how much time can be saved if the game progresses along the lines of the principal variation. Himstedt uses clear examples that he illustrates with abundant diagrams which invite the reader to get into the nitty-gritty details of Optimistic Pondering. He also presents a mathematical model for the theoretical speedup achieved on the basis of stochastic distribution models. Chapter 4 describes the selfplay experiments that Himstedt carried out in order to determine the effect of the various concepts on the playing strength. He chose to express the improvements in terms of absolute Elo ratings rather than speed increases of the search process. (In separate experiments Himstedt does determine speedups by using the BT2630 test suite of 30 positions created by Bednorz and Tönissen.) Each experiment consisted of playing 70 games that started from 35 neutral opening positions taken from the ECO (both as Black and as White) by each particular configuration against a single-core version. There were three separate sets of

experiments to measure the playing strength of (1) the YBWC for a cluster, (2) Optimistic Pondering, and (3) the combination of the YBWC and Optimistic Pondering. It lies beyond the scope of this review to go more deeply into the details of all these experiments and the interested reader is invited to read Kai Himstedt's full thesis. The bottom line is that the combination of the YBWC and Optimistic Pondering increases the playing strength more than the individual approaches. In tournament play this has paid off as both GRIDCHESS and CLUSTER TOGA (a stand-alone version of GRIDCHESS) did quite well (third place) in the WCCCs of 2007 and 2008.

Finally, Chapter 5 presents a summary and suggests some ideas for future research, specifically on how to improve the Optimistic Pondering concept.

Which brings me to the wrap-up. I have raised the question before: why do so many German (computer science) researchers publish their PhD thesis in German, and not in English? On the assumption that you want other researchers to read your work, why would you publish it in a language that most of your colleagues in the field cannot read? I believe that it used to be mandatory in the German university system to deliver your PhD thesis in the German language. But that is no longer the case. I even checked it in the *Promotionsordnung* (promotion rules) where on page 8 it clearly states that a thesis may be written in either German or English. So please do yourself and many other people a big favour and publish your PhD thesis in English.

Let me end on a happier note. I really enjoyed reading this thesis. It is a thorough piece of work in the best tradition of computer chess research, and it has some interesting findings. Who knows, the two-tiered approach to massive parallel computing might also benefit researchers in other fields than computer games. Himstedt does not elaborate on that idea, and only mentions that this method will work even better in games where the principal variation is more predictable than in Chess. *Offensichtlich* (obviously). And speaking for those who cannot read German or do not want to spend 46 euros ($60) on this thesis – why is it not for free? At least the PDF? – I say: kudos to Kai Himstedt for publishing the main findings of his PhD thesis research in an excellent paper in this journal (Vol. 35, No. 2 – June 2012).