Efficient Parallel Framework for HEVC Deblocking Filter on Many-core Platform

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ITU-T and ISO/IEC establish a Joint Collaborative Team on Video Coding (JCT-VC) to develop a new video coding standard, called High Efficiency Video Coding (HEVC). HEVC aims to provide a doubling in coding efficiency with respect to the H.264/AVC High Profile, delivering the same video quality at half the bit rate. The price to be paid for higher coding efficiency is higher computational complexity. HEVC encoders are expected to be several times more complex than H.264/AVC encoders. The Widespread deployment of many-core platform accelerates the parallelization researches on compression algorithms. Unlike H.264/AVC, where parallelism was an afterthought, HEVC currently contains several proposals aimed at making it more "parallel-friendly". Parallelizing HEVC deblocking filter (DF) is an important part of it.

DF is composed of three sub tasks, edge discrimination (ED), boundary strength computation (BSC) and filtering, which have complex data dependencies among each other. Some researchers propose an efficient order-changed parallel method (OCPM). In order to make HEVC DF more "parallel-friendly", OCPM changes the order of filtering. ED, horizontal filtering and vertical filtering can be parallelized in sequence. The order of filtering is different from that of the conventional filtering. OCPM incurs considerable loss in coding efficiency. Meanwhile, there are still complex data dependencies between BSC and filtering, which are not easily to be parallelized. The parallelism of OCPM still has some room for improvement. It is urgently demanded to parallelize the HEVC DF efficiently.

We propose an efficient parallel framework for HEVC DF on many-core platform. Firstly, we process ED and BSC with unfiltered pixels. The ED and BSC have no data dependency on filtering. We parallelize ED and BSC before filtering, which exploit the implicit parallelism. OCPM changes the order of filtering because it's difficult to parallelize conventional filtering. On the premise of keeping the filtering order the same as that of the conventional filtering, we parallelize filtering with directed acyclic graphs (DAGs).

Compared with the well-known OCPM, experiments conducted on a Tile64 platform show that our proposed method saves averagely 37.18% and 37.93% DF time with different quantization parameters (QPs). Meanwhile, our proposed method improves coding efficiency, which achieves an average BD-rate reduction of 0.09%, 0.11% and 0.12% for Y, U and V components, respectively.

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